ORDNANCE

LAND · SEA · AIR

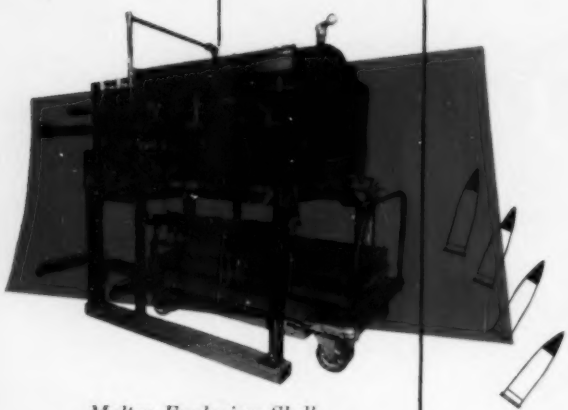
Long-range Artillery—1954

JULY-AUGUST 1954

TRIPLEX

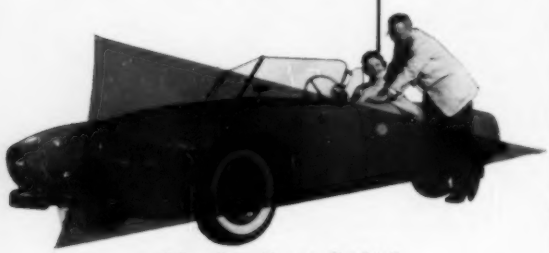
"Changing the Subject"

. . . from high explosives standby to the "new idea" products illustrated here . . . Triplex does it by combining a well-equipped plant with production know-how and imaginative engineering.



Molten Explosives Shell and Rocket Pouring Equipment.

Combination Gasoline—Electric Driven Truck and Trailer Refrigeration Units.



Fiberglass Boats, Bathtubs, and Sports Car Bodies.

High Production—Fully Automatic Bag Forming, Filling, and Sealing Machines.

Both Horizontal and Vertical Hydraulic Truck Cranes Mount on Eighteen Inches on Any Standard Truck Frame.

TRIPLEX

Standard of the Industry

TRIPLEX INDUSTRIES, INC.

CHICAGO 27, ILL. • PHONE: RIVERDALE 2200 • WRITE, WIRE OR PHONE **FRANK A. HINGER**

DESIGNERS and BUILDERS • HIGH EXPLOSIVE SPECIALISTS • MANUFACTURERS

ORDNANCE

LAND · SEA · AIR

The Magazine of Scientific and Industrial Preparedness

VOL. XXXIX JULY-AUGUST 1954 NO. 205

The Cover.—*The Corporal, recently added to our growing arsenal of missiles, is a long-range, surface-to-surface weapon which can carry a conventional or atomic warhead under guidance at supersonic speed to targets far beyond the ranges of the 280-mm. gun or the Honest John rocket, enabling a field commander to strike selected targets deep in enemy territory.*

Editor: Leo A. Codd. *Managing Editor:* R. E. Lewis. *Editorial Staff:* M. L. Van Horn, R. K. Smith.

Contributing Editors: J. J. O'Connor, F. W. Foster Gleason, Burton O. Lewis, J. M. P. Wright, R. J. Warfel.

Staff Assistants: G. C. Anderson, W. P. Cooke, G. M. Crump, F. G. Ferriter, M. E. Ferriter, K. C. Hankey, E. E. Meredith, D. P. Perakis, E. W. Rendelman, B. M. Rounds, M. P. Saccoccia, M. J. Webb, N. A. Woodhouse.

Advertising Representative: Thomas O. Woolf & Son, 70 E. Forty-fifth Street, New York 17, N.Y.

ORDNANCE is published bimonthly by the American Ordnance Association, 708 Mills Building, Washington 6, D.C. Entered as second-class matter, August 14, 1920, at the Post Office at Washington, D.C., under the Act of March 3, 1879. Additional second-class entry at the Post Office at Richmond, Va. Subscription rate: Continental United States and possessions, $4.50 annually in advance; foreign, $6.00.

Copyright 1954 by the American Ordnance Association.

Title registered United States Patent Office. Six weeks' notice before next publication date required for change of address. FIREPOWER and LOGISTICS, formerly published by the American Ordnance Association, are now combined with ORDNANCE magazine.

FEATURES

Long-range Artillery—1954 . . . . . **Front cover**
Army photo of the Corporal surface-to-surface guided missile

George H. Roderick . . . . . **Frontispiece**
Official Army photo of the Assistant Secretary of the Army for Financial Management

Finances and the Army **33**
Effective direction will achieve substantial economies

Unity for Survival . . . **Lieut. Gen. Emmett O'Donnell, Jr.** **34**
The Deputy Chief of Staff, U.S.A.F., comments on the national security

The Aircraft Industry . . . . . **August C. Esenwein** **37**
Quantity airplane production despite design changes

The Walsh Essay Contest for 1954 . . . . . **40**
Announcement of conditions for the annual $1,000 competition

Ordnance Away! . . . . . **Capt. John C. Burney, Jr.** **41**
Meeting the demand for better methods of aërial delivery of matériel

The New Look in Missiles **45**
Photos of the Honest John, Sparrow, Corporal, and Viking

Steel Cartridge Cases . . . . . **William N. King** **49**
Problems involved in the manufacture of caliber .45 ammunition

Watertown Remembered . . **Brig. Gen. Thomas K. Vincent** **53**
Recollections of General Tracy Dickson and the old Ordnance School

Our New Armored Firepower **60**
Photographs of the T43 heavy tank and new self-propelled artillery weapons

Guided Missile Production . . . **Lieut. Col. S. M. Smolensky** **64**
A résumé of problems encountered in missile development and maintenance

Month by Month **68**
Highlights of the national defense

Armament Research **71**
An editorial about the continuing quest for better weapons

Aërial Striking Power **72**
Illustrations of the F94-C Starfire and the new 20-mm. aircraft cannon

Industrial Preparedness **73**
Bulletin on the progress of A.O.A. Technical Divisions and Committees

DEPARTMENTS

Atomic Energy	**26**	**Communications**	**104**
Association Affairs . . .	**77**	**From the Record** . . .	**110**
Materials Progress . . .	**86**	**Book Reviews**	**114**
New Developments . . .	**94**	**Index of Advertisements** .	**167**

ARMAMENT TECHNOLOGY

Dynamics of Air Warfare . . **Brig. Gen. L. I. Davis, U.S.A.F.** **153**
We must be able to destroy enemy air power on the ground

Air Power and Research . . **Col. Philip S. Robbins, U.S.A.F.** **157**
The task of assuring and maintaining the superiority of the U.S.A.F.

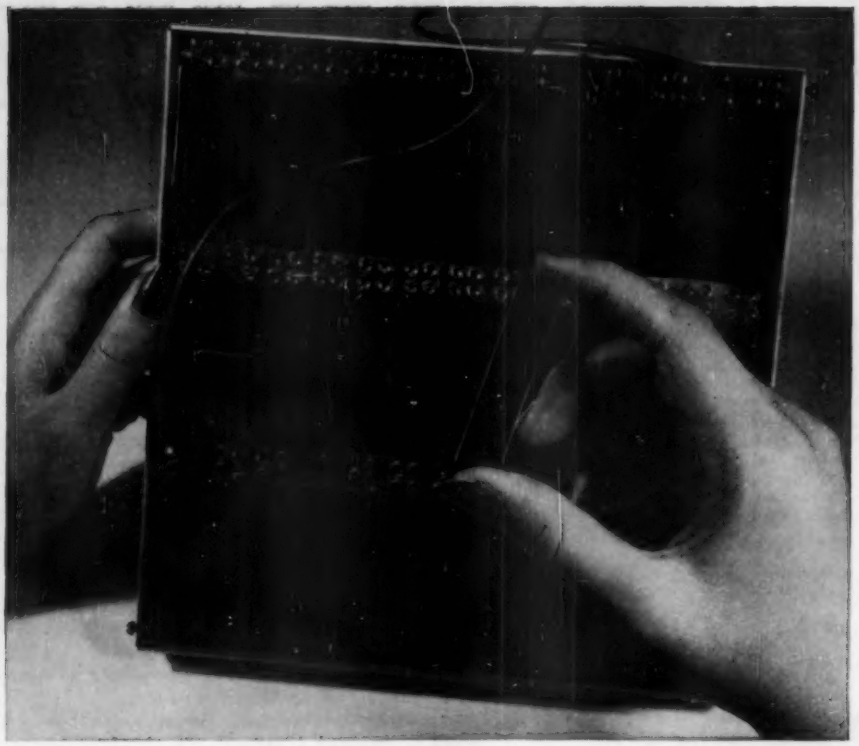
Aircraft Armament . . . . **Col. Robert T. Fincke, U.S.A.F.** **160**
New developments are needed to solve problems of firepower at supersonic speeds

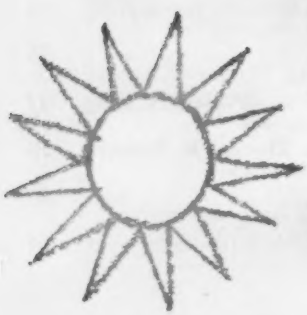
Aërial Fire Control . . . . **Col. Leroy L. Stefen, U.S.A.F.** **162**
Air Force researchers are seeking more accurate and efficient bombing systems

Packaging in Modern War . **Col. James N. Sammons, U.S.A.F.** **164**
Matériel must reach the field quickly, economically, and in usable condition

Fatigue Testing Machine . . . . . **David E. Driscoll** **166**
The application of electronic controls for more accurate results

The Bell Solar Battery. A square yard of the small silicon wafers turns sunshine into 50 watts of electricity. The battery's 6% efficiency approaches that of gasoline and steam engines and will be increased. Theoretically the battery will never wear out. It is still in the early experimental stage.





Bell Solar Battery

Bell Laboratories scientists have created the Bell Solar Battery. It marks a big step forward in converting the sun's energy directly and efficiently into usable amounts of electricity. It is made of highly purified silicon, which comes from sand, one of the commonest materials on earth.

The battery grew out of the same long-range research at Bell Laboratories that created the transistor—a pea-sized amplifier originally made of the semiconductor germanium. Research into semiconductors pointed to silicon as a solar energy converter. Transistor-inspired techniques developed a silicon wafer with unique properties.

The silicon wafers can turn sunlight into electricity to operate low-power mobile telephones, and charge storage batteries in remote places for rural telephone service. These are but two of the many applications foreseen for telephony.

Thus, again fundamental research at Bell Telephone Laboratories paves the way for still better low-cost telephone service.

Inventors of the Bell Solar Battery, left to right, G. L. Pearson, D. M. Chapin and C. S. Fuller – checking silicon wafers on which a layer of boron less than 1/10,000 of an inch thick has been deposited. The boron forms a "p-n junction" in the silicon. Action of light on junction excites current flow.

BELL TELEPHONE LABORATORIES

IMPROVING TELEPHONE SERVICE FOR AMERICA PROVIDES CAREERS FOR CREATIVE MEN IN SCIENTIFIC AND TECHNICAL FIELDS

Why *the CAT* No. 6 Shovel is No. 1 for stockpiling, loading*

Wherever big stockpiles of material have to be handled, the Caterpillar No. 6 Shovel is proving itself as the most efficient unit in the field.

Industrial Aggregate Co., of Minneapolis, Minn., is a major supplier of washed sand, buckshot gravel and standard aggregates for the surrounding area. At its large stockpile in northeast Minneapolis a Cat No. 6 Shovel loads some 500 tons of material a day, in addition to bulldozing around the yard. Average time for loading a 7-yard truck is only 76 seconds.

A. J. Egan, general manager, says: "This shovel is giving us good service. We like the hydraulic controls that make truck-loading easy. It's a good machine—that's what we expected of Caterpillar-built products."

The bucket of the Caterpillar No. 6 Shovel is 8 feet wide, with a capacity of 2 cubic yards. Its replaceable cutting edge is specially hardened for long wear. Rugged box-section lift arms are cross-braced for extra strength, and provide high lift for easy loading.

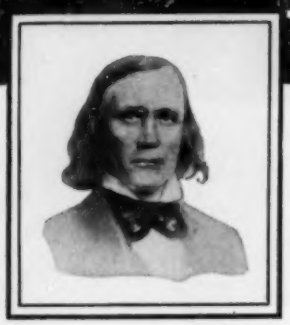
This big yellow machine is built to do more work, at lower cost, and to stay on the job longer than any competitive unit. Factual records prove its economy and high production. Your Caterpillar Dealer will gladly give you a demonstration—on the job. You can depend on him for prompt, reliable service. Call him today.

Caterpillar Tractor Co., Peoria, Ill., U.S.A.

CATERPILLAR*

*Both Cat and Caterpillar are registered trademarks—®

NAME THE DATE... YOUR DEALER WILL DEMONSTRATE



Cavalcade of American Hunters

Indians called him "Monarch of the Prairies." Historians have given him the fancy title "Nestor of the Rocky Mountains." But to most of us, he's just plain "Kit" Carson, one of the greatest hunters and adventurers of all time.

"Kit" was made for the outdoor life—and loved it. This man of the gun blazed trails with Frémont . . . scouted for the Army . . . hunted and trapped throughout the chartless West. His weapon was his life: "During sixteen years, my rifle furnished almost every particle of food upon which I lived." Though a modest man, Carson's writings cannot hide the pride and satisfaction he felt on downing game—"We made a good hunt . . ." It's a feeling only hunters get to know.

Americans have long taken to hunting because it challenges wits, reflexes, stamina and skill. Equally important, it's known for building self-reliance and endurance . . . valuable contributions to America's strength.

Today, the great tradition of hunting can be perpetuated only through thoughtful preservation of wild life. All over the country, hunting associations are cooperating with public agencies to promote proper conservation and management of our game resources. Do your part in preserving the great heritage of hunting. Join one of these public-spirited groups now. E. I. du Pont de Nemours & Co. (Inc.), Explosives Department, Wilmington 98, Delaware.

N·R·A RANGER

GET YOUR FREE BOOKLET on how to start a rifle club . . . win Ranger Shooting Emblems. Sportsmen's Service Bureau, Department D-2, Sporting Arms and Ammunition Institute, 250 E. 43rd St., New York 17, N. Y.

DU PONT
REG. U. S. PAT. OFF.

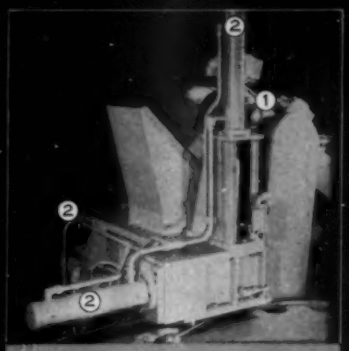
DU PONT SPORTING POWDERS

WORLD-FAMOUS SINCE 1802

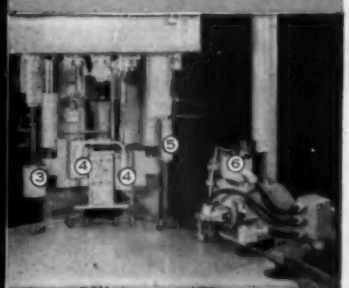
BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

HOW W. F. & JOHN BARNES SPECIAL EQUIPMENT DESIGNING AND BUILDING SERVICE

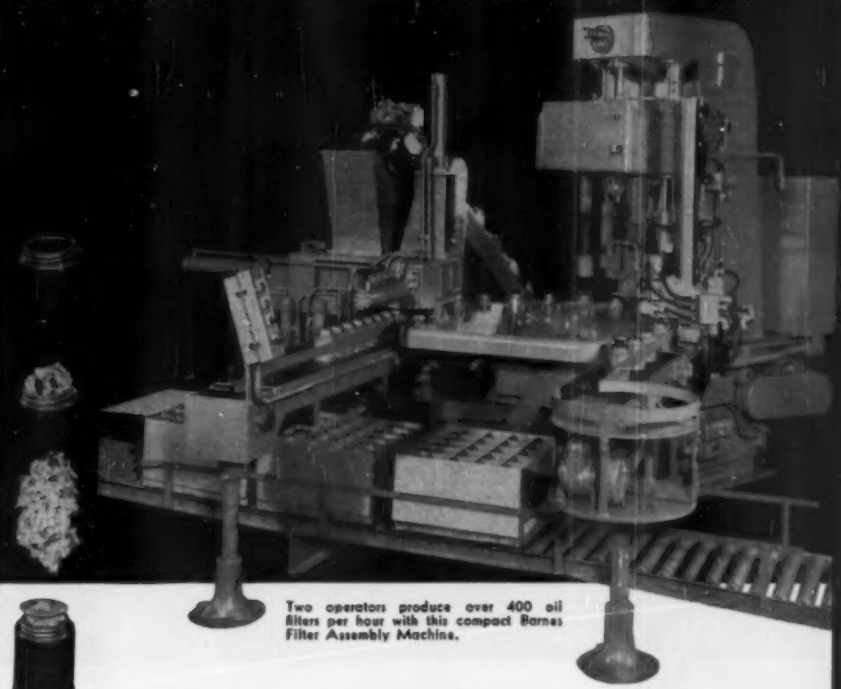
increased production 220% *through* AUTOMATIC ASSEMBLY *of oil filters*



Operator stationed at front of machine feeds empty cans from cartons at the left-hand side. Cans are automatically conveyed to star wheel. Second operator at rear of machine measures cotton waste, which conveyor (1) carries to hopper of compressing and loading cylinders (2). Same operator places wire screen and retainer on filter as it indexes to the next station.



Automatic plunger (3) forces screen and retainer into filter body. Two oscillating air drills (4) weave oil hole through cotton waste. Automatic gauge (5) checks depth of hole, ejecting defective units from machine. Next unit (6) automatically adds cork gasket to complete the assembly. Cartons are moved along conveyor to the discharge side of the machine, where they are repacked with completed filters.



Two operators produce over 400 oil filters per hour with this compact Barnes Filter Assembly Machine.

Oil Filter assembly production boosted from 125 to over 400 units per hour . . . that's the result story of this Barnes Filter Assembly Machine now at work for a large farm implement manufacturer. And equally as important, a higher-quality, more uniform product is being obtained with only one-third the personnel formerly required.

Once again the wide experience of W. F. & John Barnes Process Equipment Division has enabled another manufacturer to substantially reduce production costs and improve product quality. This special machine is only one of many widely diversified types now successfully and profitably cutting costs and increasing production output in hundreds of plants throughout the country.

Here at Barnes you'll find the varied engineering and creative skills, PLUS over 75 years of machine building background, to help you solve troublesome production problems. And because all planning, engineering, and manufacturing efforts are closely coordinated, you have available a complete *Automation Equipment Service* from one convenient and *experienced* source.

ASK TO HAVE YOUR PRODUCTION METHODS ANALYZED

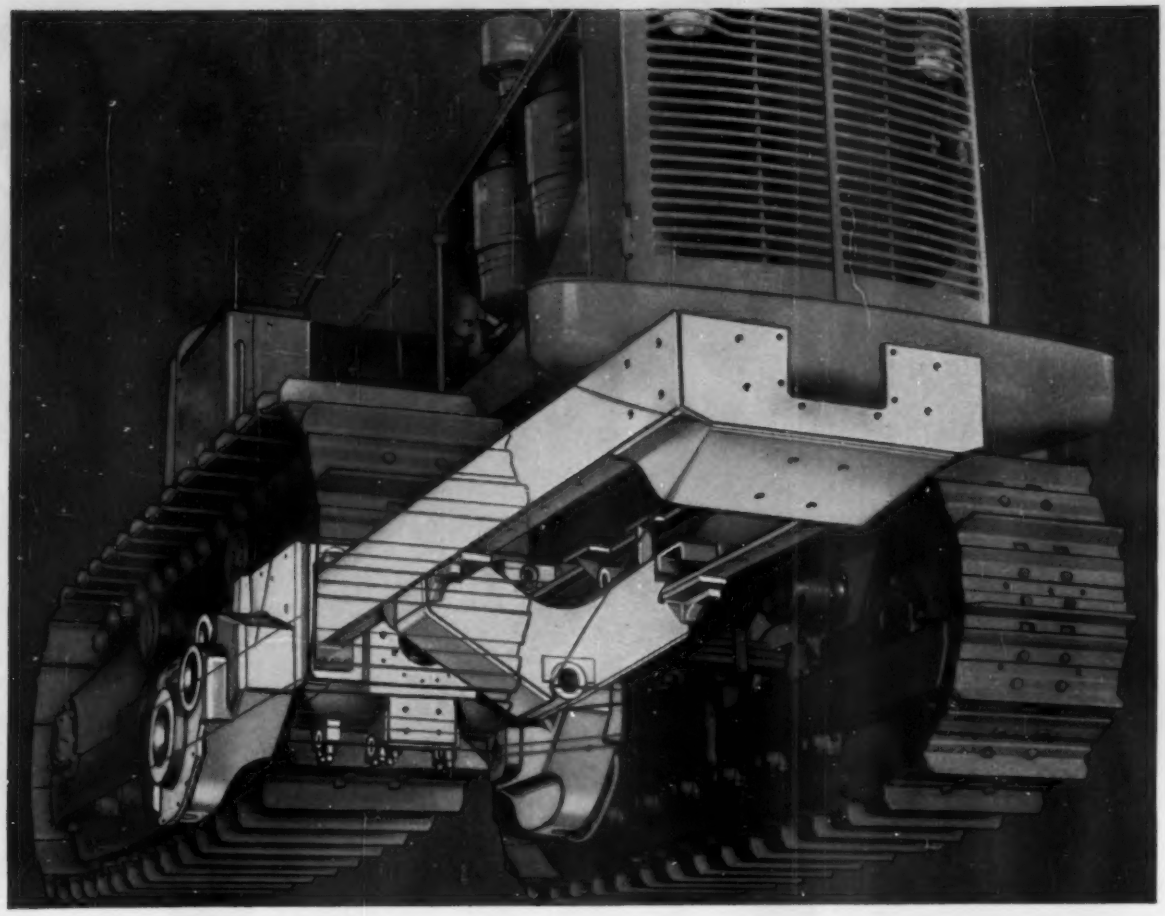
Find out how these unique creative and specialized resources can help you cut costs. Your problem will be given expert and individual attention.

GET THIS *Free* BOOKLET

Write today for your copy of "Coordinated Creative Engineering and Manufacturing" — a 32-page booklet of cost-cutting *Automation Equipment* ideas.

W. F. & JOHN BARNES COMPANY
PROCESS EQUIPMENT DIVISION
308 SOUTH WATER STREET • ROCKFORD, ILLINOIS

BUILDERS OF BETTER MACHINES AND EQUIPMENT SINCE 1872



Allis-Chalmers Advanced Engineering
THE FOUNDATION OF BETTER PERFORMANCE

Today's earth-moving and construction techniques, plus greater use of mounted equipment, have placed constantly increasing demands on crawler tractor performance. To meet these demands, Allis-Chalmers engineers have completely redesigned their tractors since the war.

Working right from the ground up, they have made full use of new metals and the latest manufacturing processes. Each part is designed and built to meet the requirements of modern job practices, with Allis-Chalmers tractors setting completely new standards of performance. One example of this advanced engineering is the exclusive box A main frame design.

This is typical of the long-range planning and research by which Allis-Chalmers engineering assures longer, more satisfactory performance in both civilian and military machines.

"ROLLS WITH THE PUNCH" — All-steel main frame flexes slightly under extreme shock loads . . . without transmitting strain to engine, clutch or transmission.

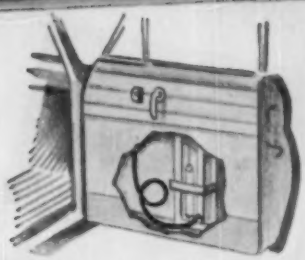
BETTER EQUIPMENT MOUNTING — This frame's compactness provides ample clearance for equipment like front-end shovels . . . permits wide track shoes . . . improves performance of entire unit.

IMPROVED WEIGHT DISTRIBUTION — Box A-frame allows location of main components for best over-all balance . . . putting more weight lower in tractor where it does the most good.

SERVICE SIMPLICITY — Since main frame carries *structural* load, power drive components can be readily removed, repaired or replaced without disturbing adjacent parts.

ALLIS-CHALMERS
TRACTOR DIVISION—MILWAUKEE 1, U. S. A.

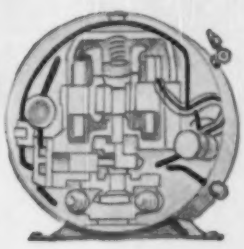
FROM *the Bundy Sketchbook*
TO *jog a designer's imagination*



AUTOMOTIVE HYDRAULIC WINDOW LIFT LINES

FRAME FOR OCCASIONAL TABLE

REFRIGERATOR COMPRESSOR LINES



REMARKS Do you have a tubing design that won't jell -- or a fabrication kink you can't untangle? Whatever your tubing headache, why not turn it over to our engineering experts. They offer you years of problem-solving experience, plus the added bonus of Bundyweld, the only tubing double-walled from a single strip (see below).

WRITE today for catalog or for help in developing your tubing ideas.

BUNDY TUBING COMPANY
DETROIT 14, MICHIGAN

SUPERMARKET PUSHCART FRAME

WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of copper-coated steel. Then it's . . .

continuously rolled twice around laterally into a tube of uniform thickness,

and passed through a furnace. Copper coating fuses with steel. Result . .

Bundyweld, double-walled and brazed through 360° of wall contact.

BUNDYWELD TUBING®

DOUBLE-WALLED FROM A SINGLE STRIP

Leakproof
High thermal conductivity
High bursting point
High endurance limit
Extra-strong
Shock-resistant
Ductile

Lightweight
Machines easily
Takes plastic coating
Takes plating
Bright and clean
No inside bead
Uniform I.D., O.D.

Bundy Tubing Distributors and Representatives: ***Bridgeport, Conn.:*** Karhumel Steel & Aluminum Co., 117 E. Washington St. • ***Cambridge 42, Mass.:*** Austin-Hastings Co., Inc., 226 Binney St. ***Chattanooga 2, Tenn.:*** Peirson-Deakins Co., 823-824 Chattanooga Bank Bldg. • ***Chicago 32, Ill.:*** Lapham-Hickey Co., 3333 W. 47th Place • ***Elizabeth, New Jersey:*** A. B. Murray Co., Inc., Post Office Box 476 • ***Los Angeles 58, Calif.:*** Tubesales, 5400 Alcoa Ave. • ***Philadelphia 3, Penn.:*** Rutan & Co., 1717 Sansom St. • ***San Francisco 10, Calif.:*** Pacific Metals Co., Ltd., 3100 19th St. • ***Seattle 4, Wash.:*** Eagle Metals Co., 4755 First Ave., South • ***Toronto 5, Ontario, Canada:*** Alloy Metal Sales, Ltd., 181 Fleet St., E.

Bundyweld nickel and Monel tubing are sold by distributors of nickel and nickel alloys in principal cities.

For ENVIRONMENTAL TEST EQUIPMENT

see Tenney

From better facilities

including expanded engineering
new, improved tooling
and faster shipping, comes

a better product

a wide range of "standards" in altitude,
temperature, humidity, sand and dust,
explosion and walk-in chambers*

for you

our customers, whose names* include
the largest firms in America,
the U. S. Government, and Armed Services.

* Information on this equipment and a purchaser list will be sent on request.

Tenney ENGINEERING, INC.

1090 SPRINGFIELD ROAD, UNION, N. J.
Plants: Union, N. J. and Baltimore, Md.

Engineers and Manufacturers of Refrigeration and Environmental Equipment

9847

Here's One Missile Launcher We Don't Make

. . . but we do make modern systems
for launching missiles against military objectives.

Maxson-developed, Maxson-built launching systems
provide the engineering features
vital to
dependable target interception.

Top-caliber engineers will find exceptional opportunities at Maxson. For details, contact G. R. Pratt.

MAXSON develops and manufactures systems, subsystems, and components in armament, navigation, electronics, and special devices.
Ask for facilities report.

MAXSON

THE W. L. MAXSON CORP.
460 WEST 34th STREET, NEW YORK, 1, N. Y.
Plants at Old Forge, Penn. and Long Island City and New York, N. Y.

Helping hands on four wheels ...

Phones ring often in the headquarters of Emergency Squad 4 on New York City's lower East side:

"A boy is buried under a coal pile. Hurry!"

"My poor cat is wedged in the doors of a telephone booth!"

"Mrs. Murray's having a heart attack. Help!"

Such urgent pleas send policemen and the green-and-white truck of E. S. 4 into immediate action. The bold, specially-equipped truck leaps toward its call of duty. On the scene, help is offered, a life is saved, pain eased, comfort given, prayers answered.

Other trucks are our friends, too. On a nation-wide network of hard, safe, well-maintained highways, dependable trucks carry items of necessity to us fresh from factories. On countless farms, trucks overflow with recently ripened crops. Delivery trucks stop right at your door with your latest purchase. A truck rides the roads to bring gasoline for your car, soft drinks for your thirst, household appliances for your comfort, theater equipment for your entertainment.

Trucks contribute immeasurably to the health and well-being of all of us ... *every day.*

IF YOU'VE GOT IT – A TRUCK BROUGHT IT!

ATA FOUNDATION INC

AMERICAN TRUCKING INDUSTRY
Washington 6, D.C.

This advertisement sponsored by
INTERNATIONAL HARVESTER COMPANY
builders of International Trucks

NOW WE FORGE IT

DESPITE ITS LARGE SIZE AND INTRICATE SHAPE

The CAMERON closed die extrusion forging process opens the door to a great many design features which heretofore had been limited to castings. The improved quality and the lower manufacturing cost which result from machining a CAMERON forging makes it highly desirable to investigate the possibility of your product being forged at CAMERON.

For further information write

FORGE AND ORDNANCE DIVISION

Cameron

IRON WORKS, INC.
HOUSTON, TEXAS

...snuffs out fire as fast as it starts

Fires strike quickly . . . anywhere, at any time. Yet you can easily protect your valuable records, structures and property with a fire protection system that is engineered and installed to guard against your particular hazard.

For there's a Blaw-Knox system to protect against any type of fire hazard in all types of structures . . . such as barracks, armories, arsenals, ordnance plants, ammunition depots, hangars, gasoline storage tanks, ships, shipyards, docks, and many more.

Blaw-Knox Fire Protective Systems carry approvals of all underwriters

Deluge Systems—Wet Pipe Systems—Dry Pipe Systems—Water Spray and Fog Systems—Rate-of-Rise Sprinkler Systems—Foam and Carbon Dioxide Extinguisher Systems.

Let a Blaw-Knox Fire Protection Engineer study your requirements and submit an estimate on a system to guard against your specific hazard . . . absolutely without obligation.

"Little Joey Sprinkler" always on the job

BLAW-KNOX COMPANY

PITTSBURGH 22, PENNSYLVANIA

BLAW-KNOX

FOR NATIONAL DEFENSE: Blaw-Knox is making anti-aircraft gun mounts and cast armor for tanks . . . and providing engineering and construction services for defense projects, including work for the Atomic Energy Commission.

BASIC PRODUCTS FOR INDUSTRY: complete chemical and processing plants • chemical and food processing equipment • rolling mills and auxiliary machinery • rolls for steel and non-ferrous mills • open hearth furnace equipment • heavy steel castings • heat and corrosion resisting alloy castings • contractors equipment • concrete and asphalt paving machinery for roads and airfields • steel forms for concrete construction • clamshell buckets • prefabricated piping systems • open steel grating • antenna and transmission towers • sprinkler systems for fire protection.

N-A-X
ALLOY STEELS

MODERN STEELS for MODERN TRANSPORTATION

- **N-A-X HIGH-TENSILE** steel—a low-alloy high strength structural steel used to reduce weight and increase life of your product.
- **N-A-X AC 9115** steel—for gas turbines and similar products requiring strength of material when operated at higher than normal temperatures up to 1000°F.
- **N-A-X 9100** series—alloy steels for carburizing and heat treated parts.

With these three N-A-X ALLOY STEELS, we offer time proven products to economically serve you.

N-A-X HIGH-TENSILE is 50% stronger than mild carbon steel with high notch toughness. Has excellent cold forming and welding properties and greater resistance to atmospheric corrosion and abrasion.

N-A-X AC 9115—a steel easily fabricated and welded by any method, maintains high strength at elevated temperatures up to 1000°F. When protected against high temperature oxidation by proper coatings, it is a worthy alternate for the higher-alloy stainless type steels for this application.

N-A-X 9100 series—a series of alloy steels with the alloying elements constant within an established range, with carbon varied to suit the hardenability and hardness desired. An outstanding carburizing steel.

GREAT LAKES STEEL CORPORATION

N-A-X Alloy Division **Ecorse, Detroit 29, Mich.**

NATIONAL STEEL CORPORATION

this Trade Mark... on ROCKETS, SHELLS, FUZES

and other ammunition metal components assures the armed forces of highest quality, delivery as promised and fair price.

HECKETHORN MANUFACTURING & SUPPLY COMPANY
LITTLETON, COLORADO

Contractors to the UNITED STATES ARMED FORCES FOR ROCKETS, SHELLS, FUZES, RESEARCH AND DEVELOPMENT

1 HIGH SPEED JETS APPROACH AIR BASE
2 RADAR DETECTS, LOCKS ON AND AUTOMATICALLY TRACKS JET
3 ELECTRONIC COMPUTER DICTATES FUTURE TARGET POSITION TO GUN
4 GUN ENGAGES AND DESTROYS JET

Army Unveils Skysweeper...

Deadly Accurate Anti-Aircraft Gun

THE STORY BEHIND THE STORY:

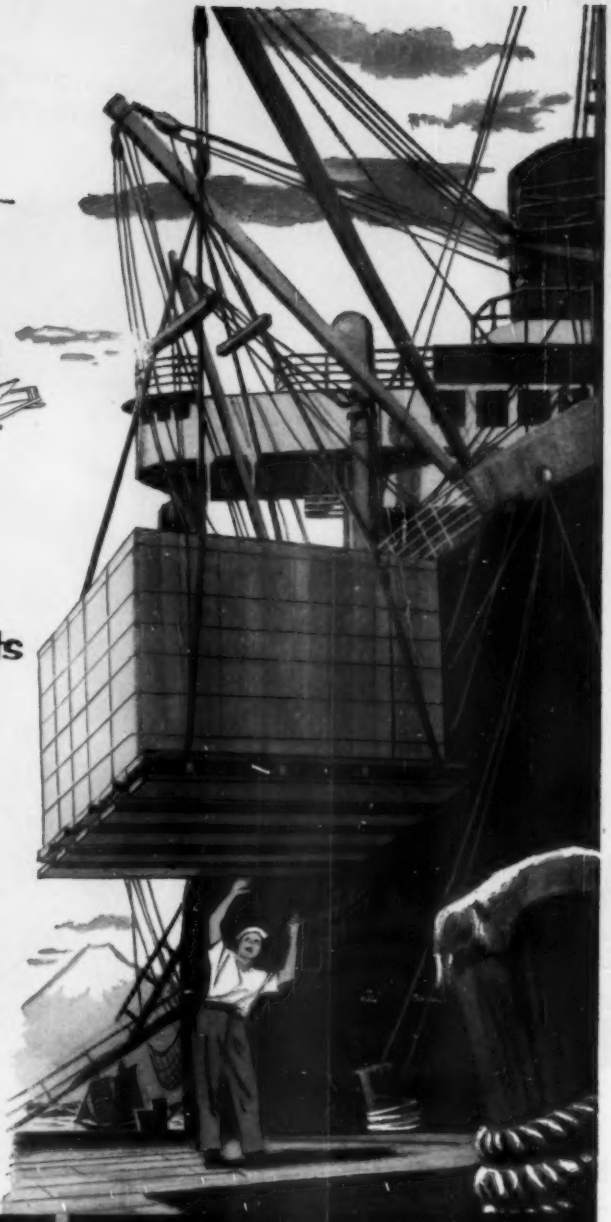
■ "HOW CAN WE stop hostile jets that slip through our primary defenses?" Newsmen covering Army Ordnance's demonstration of the Skysweeper saw the answer to attack by high-speed aircraft at medium range—and spread the story over front pages from coast to coast. It was the story of a gun that could "see" through fog and darkness . . . pick out an enemy within a 15-mile radius . . . compute its speed, altitude and course in seconds . . . then, automatically aiming itself, shoot the plane out of the sky.

■ Actually the story began when Army Ordnance anticipated the threat of faster flying jets and started to work with Sperry on the problem. Through its pioneering in radar, Sperry engineers were able to design the "eyes" of needed performance. From Sperry's experience in electronics came the "brains" to compute precise firing information. Sperry's developments in servo mechanisms provided the "muscles" for rapid aiming and firing.

■ The Skysweeper gunfire control *system* which resulted from the cooperative efforts of Army Ordnance and Sperry is typical of the many systems which Sperry has developed working with various branches of the military to meet critical needs. Once developed, Sperry manufacturing specialists convert engineering designs into precision weapons for large scale production. Among similar projects at Sperry today are systems for bombing and navigation, missile guidance and naval gunfire control.

SPERRY GYROSCOPE COMPANY

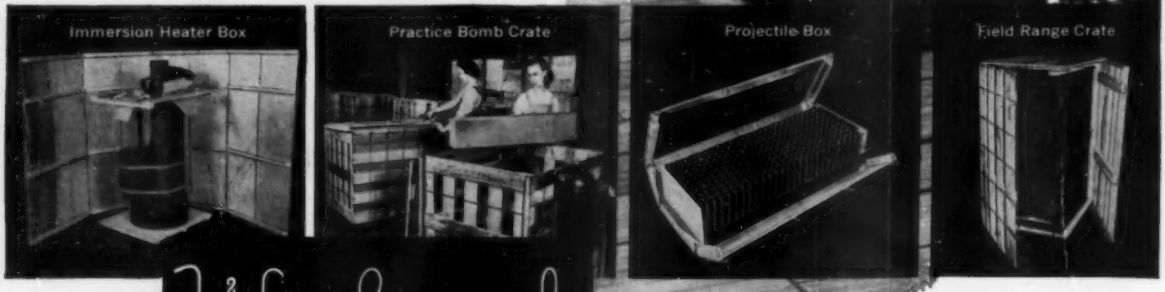
DIVISION OF THE SPERRY CORPORATION • GREAT NECK, N.Y.



Everyday
more and more service shipments
go **WIREBOUND**

An ever increasing number of suppliers are taking advantage of improved Military and Federal specifications so that they may obtain the benefits of Wirebound containers for Armed Service shipments. They've found Wirebound box manufacturers well qualified to supply containers that meet government requirements for parts, equipment, over-packs, food and hundreds of other uses. Wirebound plants throughout the country are up-to-date on Armed Service shipping specifications and have the experience, technical know-how and testing facilities to produce the best container for each use. Why not check with your Wirebound supplier or write for full information!

Wirebound Box Manufacturers Association
Room 1163, 327 South LaSalle Street, Chicago 4, Illinois

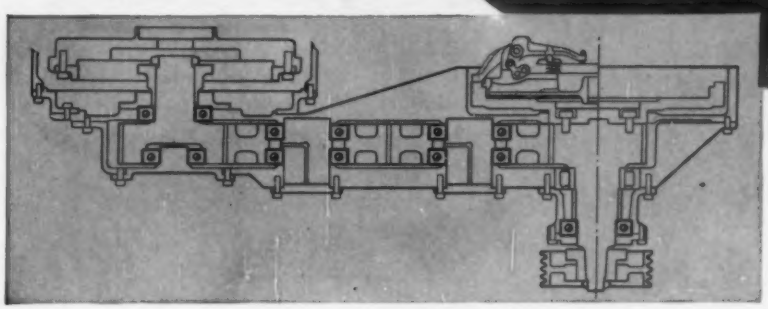


Wirebound
BOXES & CRATES

75 WIREBOUND BOX PLANTS are ready to serve you!

NEW DEPARTURES at work in Dart's new monster

This dual-engine giant has two torque converters, two transfer cases and two reverse gear boxes in which New Departure applications are found. Cross section of transfer case shows seven **ball** bearings—all New Departures!



Weight—50 tons! Payload—75 tons! It's Dart's mighty Monster, world's biggest truck; yet it's agile, too. Here's where New Departure **ball** bearings carry the loads . . . in the transfer cases, reversing gears and torque converters that deliver a 700-horsepower drive to tandem rear axles.

Whatever the load . . . radial, thrust or any combination . . . New Departure **ball** bearings mean precision performance. They maintain accurate positioning of gears and shafts . . . reduce wear and maintenance to the minimum.

Learn what *ball* bearings can do for *your* product . . . talk to your New Departure engineer—soon!

NOTHING ROLLS LIKE A BALL

NEW DEPARTURE

BALL BEARINGS

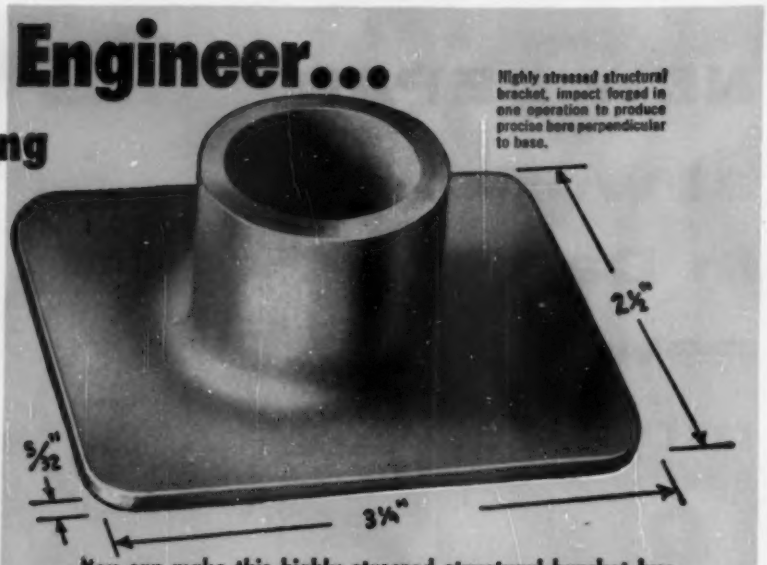
NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT
Plants also in Meriden, Connecticut, and Sandusky, Ohio
In Canada: McKinnon Industries, Ltd., St. Catharines, Ontario

NEW DEPARTURE SALES ENGINEERING OFFICES—AT YOUR SERVICE

BRISTOL	269 North Main St.	2-6371	**DETROIT**	7-122 General Motors Bldg.	Trinity 2-4700	**KANSAS CITY**	1021 E. Linwood Blvd.	Valentine 4939
BOSTON	517-A Park Square Bldg.	Hancock 6-9867	**CINCINNATI**	2107 Carew Tower	Main 5783	**MILWAUKEE**	647 W. Virginia St.	Broadway 6-9460
KANNAPOLIS, N. C.	P. O. Box 1086	2-3181	**CLEVELAND**	3113 W. 110th St.	Winston 1-5454	**ST. LOUIS**	3001 Washington Blvd.	Franklin 6533
NEW YORK	1775 Broadway	Circle 6-1540	**INDIANAPOLIS**	1357 W. 18th St.	Imperial 4680	**LOS ANGELES**	5035 Gifford Ave.	Logan 8-2301
PHILADELPHIA	850 E. Luzerne St.	Garfield 3-4136	**PITTSBURGH**	Cathedral Mansions	Mayflower 1-8100	**BERKELEY**	1716 Fourth St.	Landscape 6-8750
SYRACUSE	2360 James St.	73-5195	**CHICAGO**	332 So. Mich. Ave.	Wabash 2-5875	**SEATTLE**	5000 First Ave., S.	Lander 5920
			DAVENPORT	2212 E. 12th St.	Davenport 7-7522			

Mr. Design Engineer...

do a little exploring


Highly stressed structural bracket, impact forged in one operation to produce precise bore perpendicular to base.
2½"
3/32"
3¼"

You can make this highly stressed structural bracket by:

1 Machining from a typical forging

Metal waste	—High
Machining cost	—High
Physical properties	—High
Material cost	—High

2 Machining from a casting

Metal waste	—High
Machining cost	—High
Physical Properties	—Low
Material cost	—Low

3 Hogging from bar stock

Metal waste	—High
Machining cost	—High
Physical properties	—Fair
Material cost	—High

4 Hunter Douglas Impact Forging

Metal waste	—Low
Machining cost	—Low
Physical properties	—High
Material cost	—Low

Every method offers an advantage, but Impact Forging offers every advantage.

Discover the advantages of

IMPACT FORGING

FROM

HIGH STRENGTH ALUMINUM ALLOYS

IMPACT FORGING is a new technique perfected by Hunter Douglas to mass produce heat-treatable aluminum alloy parts with close dimensional tolerances and forged grain flow. Impact Forging forces the material to the desired shape by direct compression with little metal waste. Many times the part is impact forged to final print in one operation, eliminating any secondary machining operations.

Impact Forging offers you variable side walls, zero draft, and close dimensional tolerances in a variety of tubular, rectangular, and symmetrical shapes. The economic advantages of Hunter Douglas Impact Forging can be best realized if you are designing a part for production in quantities of 1 thousand to 1 million a month. Impact Forging gives close dimensional tolerances, micro-precise surface finish, and the high physical properties of a forging. Spark your imagination and improve your position in the competitive field by investigating the advantages of Hunter Douglas Impact Forging.

write for free brochure on your company letterhead

HUNTER DOUGLAS *CORPORATION*

DEPT. O-7 • RIVERSIDE, CALIFORNIA • TELEPHONE RIVERSIDE 7091

EXACTLY what's needed when needed

The modern production facilities of Kwikset Defense Products provides our armed forces with the highest quality 30-calibre machine gun belt links. Kwikset precision manufacturing techniques are combined with mass production methods to assure the most dependable ordnance products for the defense of our Nation.

KWIKSET DEFENSE PRODUCTS • ANAHEIM, CALIFORNIA

A DIVISION OF KWIKSET LOCKS, INC.

NEW PROTECTIVE COATING CHEMICAL FOR ALUMINUM

ALODIZING

Alodizing with "Alodine,"* a new technique in the protective coating of aluminum, was made available for production-scale use in 1946. Since that time Alodizing has largely supplanted the more elaborate, costly and time-consuming anodic treatments in the aircraft and other industries.

Continuous and successful industrial use has clearly demonstrated the simplicity and economy of the Alodizing process as well as the effectiveness of the "Alodine" amorphous coatings, particularly as a base for paint. In fact, the paint-bond that Alodized aluminum provides has been found to be superior to that possible with chromic acid anodizing.

The corrosion-resistance of unpainted aluminum Alodized with "Alodine" Nos. 100 or 300 is excellent, easily meeting the requirements of Specification MIL-C-5541. However, a need for protection of unpainted aluminum, even better than that obtained with chromic acid anodizing, has long been recognized.

NEW IMPROVED "ALODINE" DEVELOPED By ACP RESEARCH CHEMISTS

Several years of intensive research have now led to a new type of "Alodine," designated as "Alodine" No. 1200. This new protective coating chemical forms an amorphous mixed-metallic oxide coating of low dielectric resistance that provides unusually high corrosion-resistance for unpainted aluminum. In addition, it forms an excellent paint bond that approaches closely the high quality obtained with the earlier types of "Alodine."

After having been tested for conformance with Specification MIL-C-5541, "Alodine" No. 1200 is now about to go into production.

PROCESS DETAILS

"Alodine" No. 1200 is the only essential chemical needed to prepare the coating bath and the final rinse bath. One of its unique features is that it can be used in tanks in an immersion process, or, in a multi-stage power washer in a spray process, or, with a slight adjustment of pH, with brush or portable spray equipment in a manual process. This means that even where the simple production equipment is not available, or where touching up of damaged coatings previously Alodized or anodized is required, excellent protection and paint bonding can still be obtained with practically no equipment.

All three methods of application easily meet the requirements of Specification MIL-C-5541.

Process sequence for all three methods of application is the same as for other standard grades of "Alodine" such as Nos. 100, 300, and 600, viz.: 1. Pre-cleaning. 2. Rinsing. 3. Alodizing. 4. Rinsing. 5. Acidulated rinsing. 6. Drying.

Coating time in an immersion process ranges from 2 to 8 minutes and in a mechanized spray process is about 30 seconds. "Alodine" No. 1200 baths are operated at room temperatures (70° to 100°F.) and heating is required only if the bath has gotten cold after a "down" period.

RECOMMENDED USES FOR "ALODINE" No. 1200

"Alodine" No. 1200 is specifically recommended for coating wrought products that are not to be painted or are to be only partially painted; and for coating casting and forging alloys whether or not these are to be painted. "Alodine" Nos. 100 and 300 are still recommended for coating wrought products such as venetian blind slats, awnings, etc., that are invariably painted.

RESULTS OF TENSILE TESTS

This new "Alodine" not only retards visible corrosion and pitting, but as shown in the table below, the loss of ductility with "Alodine" No. 1200, both brush and dip, after 1000 hours salt spray was less than for chromic acid anodizing after 250 hours, and for "Alodine" No. 100 and a conventional chromate treatment after 168 hours exposure.

PROCESS	SALT SPRAY EXPOSURE	COMPLIANCE WITH TENSILE REQUIREMENTS OF MIL-C-5541
CHROMIC ACID ANODIZING	168 hrs.	passes
	250 hrs.	passes
	500 hrs.	fails
	1000 hrs.	fails
BRUSH "ALODINE" No. 1200	168 hrs.	passes
	250 hrs.	passes
	500 hrs.	passes
	1000 hrs.	passes
DIP "ALODINE" No. 1200	168 hrs.	passes
	250 hrs.	passes
	500 hrs.	passes
	1000 hrs.	passes
DIP "ALODINE" No. 100	168 hrs.	passes
	250 hrs.	fails
	500 hrs.	fails
	1000 hrs.	fails
CONVENTIONAL CHROMATE TREATMENT	168 hrs.	passes
	250 hrs.	fails
	500 hrs.	fails
	1000 hrs.	fails

*"Alodine" Trade Mark Reg. U. S. Pat. Off.

CHEMICALS ACP PROCESSES

AMERICAN CHEMICAL PAINT COMPANY

General Offices: Ambler, Penna.

Detroit, Michigan **Niles, California** **Windsor, Ontario**

"TWO MORE REASONS WHY WE CHOSE A PLANE WITH CONTINENTAL POWER"

After engine dependability, the most important thing to consider in choosing an airplane is the service behind it—the facilities maintained by its makers to keep it in the air at lowest cost. And here, as on the basic score of engine stamina, planes with Continental power rate uniformly high.

Owners of such aircraft are sure of finding genuine Continental parts and competent mechanics wherever they may fly. They benefit in other ways, too, from Continental's policy of backing those who build and those who use Continental-powered products.

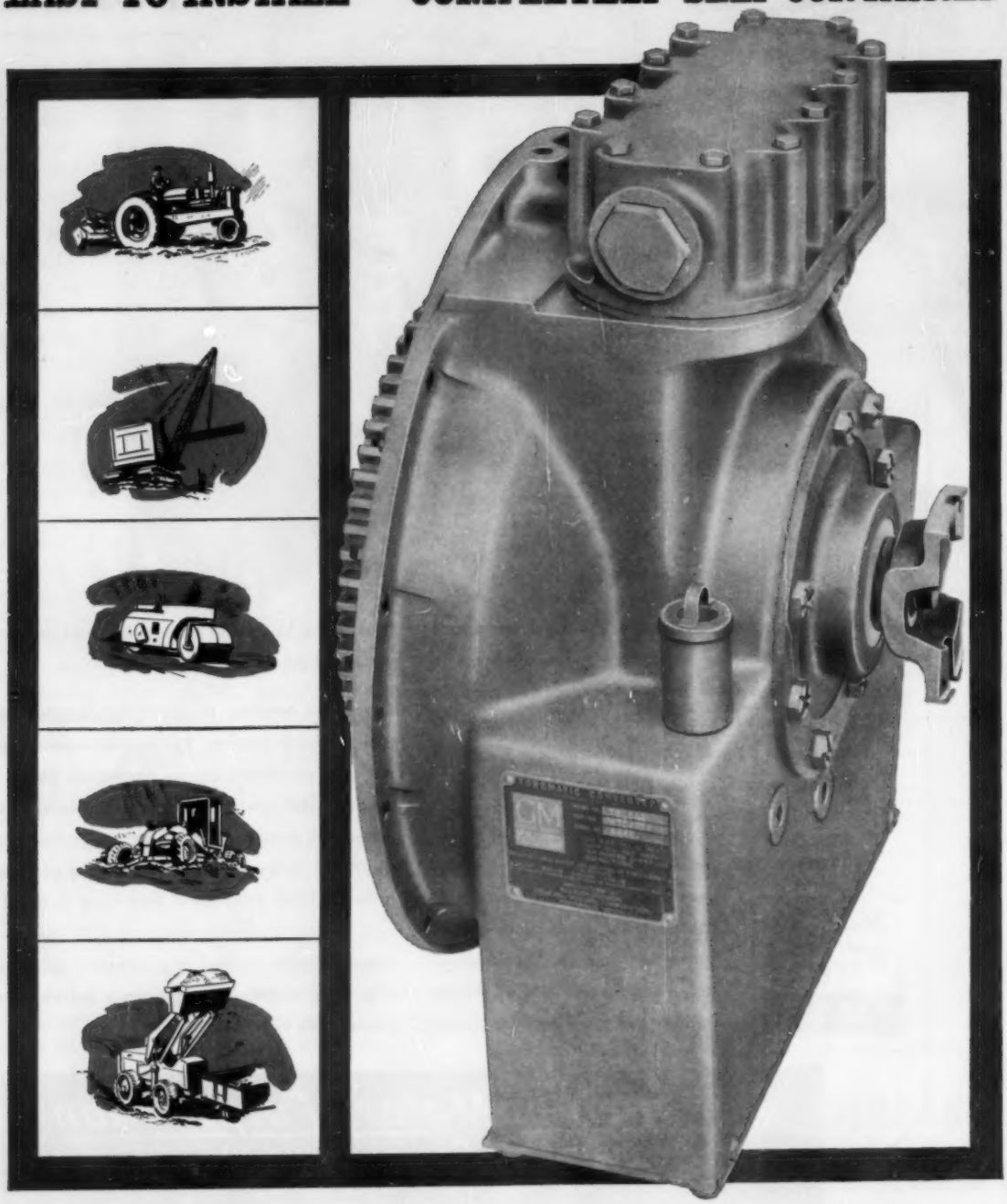
SERVICE EVERYWHERE

Corporate owners, in particular, appreciate the plan which makes factory-remanufactured engines available on an exchange basis. This Continental-pioneered service, now several years old, practically eliminates dead time when overhaul is required, and provides a guaranteed power plant, with zero hours, at a fixed low cost. Being available through 125 master distributors with dealers at practically all airports, it is truly another good reason for choosing a plane with Continental power.

Continental Motors Corporation
Aircraft Engine Division
MUSKEGON, MICHIGAN

NOW LOW-COST HEA

EASY TO INSTALL **COMPLETELY SELF-CONTAINED**



VY-DUTY TORQMATIC CONVERTERS

For 40-150 HP Gasoline- or Diesel-Powered Equipment

HERE, for the first time, are Allison TORQMATIC Converters designed for hard-working gasoline- or Diesel-powered equipment in the medium horsepower range.

These new torque converters are true heavy-duty units *priced to compete* with converters designed primarily for passenger cars—*priced to sell for less* than most comparable industrial-type converters.

And they fit your equipment with little or no change in your design.

Easy installation

New Allison TORQMATIC Converters are completely self-contained for simplified flexible installation—feature integral oil system including charging pump, oil cooler and oil sump. No outside oil lines required. Integral gear drive for easy mounting.

Standard SAE #3 mounting dimensions and conventional internal-external drive gear like that used in ordinary clutch power take-offs simplify installation.

Three different models give you a wide selection of torque ratio and capacity.

Options include front disconnect clutch and adapter, rear disconnect clutch adapter, standard flange as shown, industrial shaft with or without governor drive and oil cooler.

Why use a torque converter?

Your equipment lasts longer with an Allison TORQMATIC Converter transmitting power because it protects engines and driven equipment from harmful shock loads—one of the main causes of equipment breakdowns.

And you get more work from your units, too. New Allison TORQMATIC Converters multiply engine torque up to 3½ times and also provide more production because they broaden your engine's effective horsepower range. When torque output equals load demand the TORQMATIC Converter acts as a fluid coupling to conserve fuel and boost engine life.

Ask your engine or equipment manufacturer about Allison TORQMATIC Converters for your hard-working 40- to 150-horsepower units or mail the coupon.

GM GENERAL MOTORS

Allison

TORQMATIC DRIVES

Allison Division of General Motors
Box 894W, Indianapolis 6, Ind.

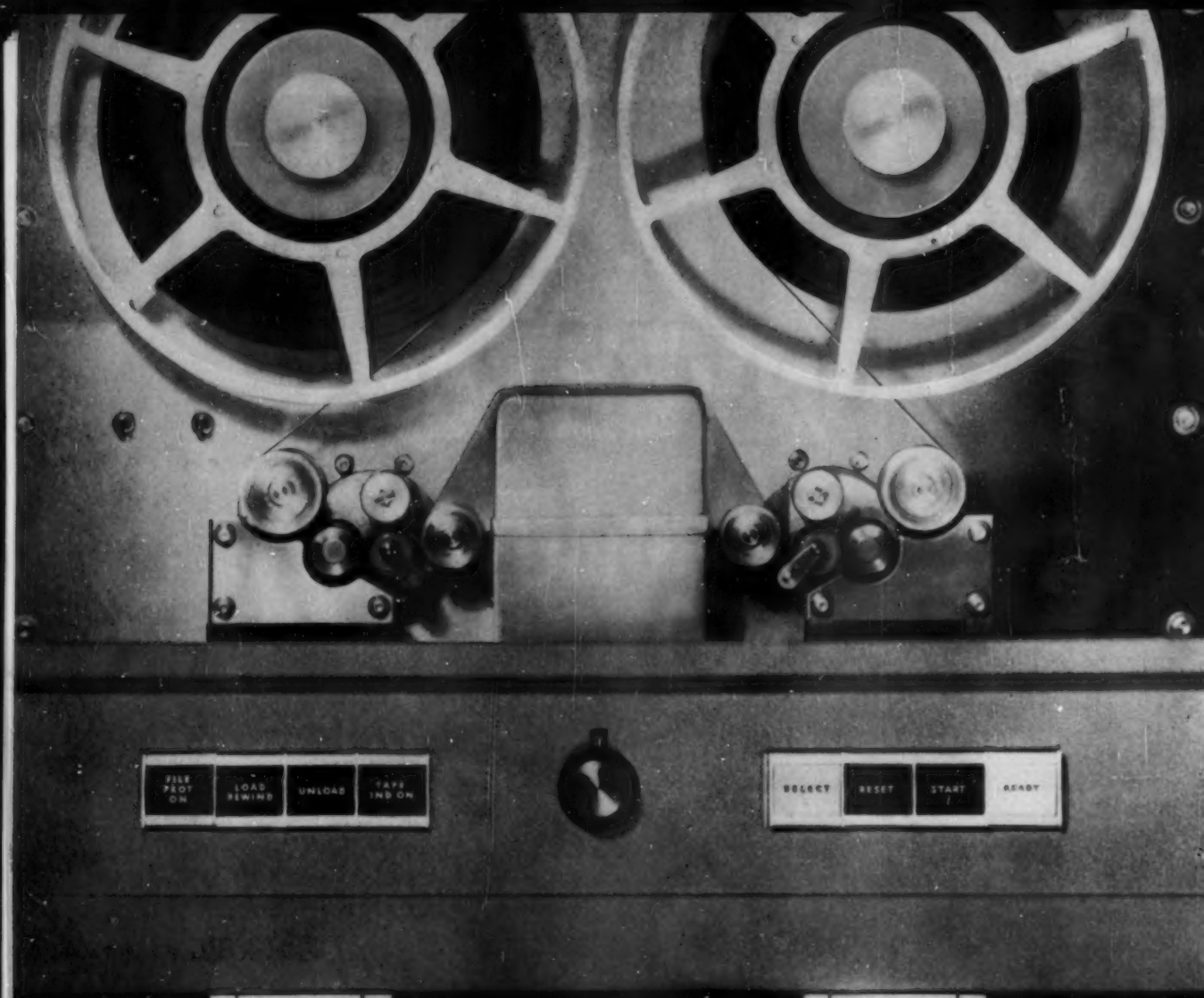
Please send me Bulletin SA 1031

Name_____

Position_____

Company_____

Address_____



A "Giant Brain" that's Strictly Business

IBM's new 702 Electronic Data Processing Machine brings to the accounting and record-keeping problems of business the speed and capacity of giant scientific computers.

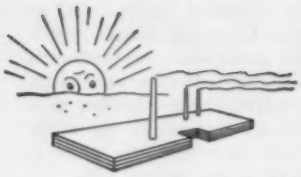
It can absorb millions of facts and figures on its magnetic tapes (shown here), process this vast quantity of data, and turn out the results in the form you need. Payrolls, billing, manufacturing and inventory control, cost allocation, manpower scheduling, fiscal accounting—all the complex operations of modern business—are performed at high speed.

This is *business* automation at its highest development.

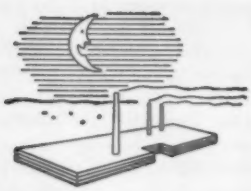
International Business Machines
590 Madison Avenue, New York 22, N. Y.

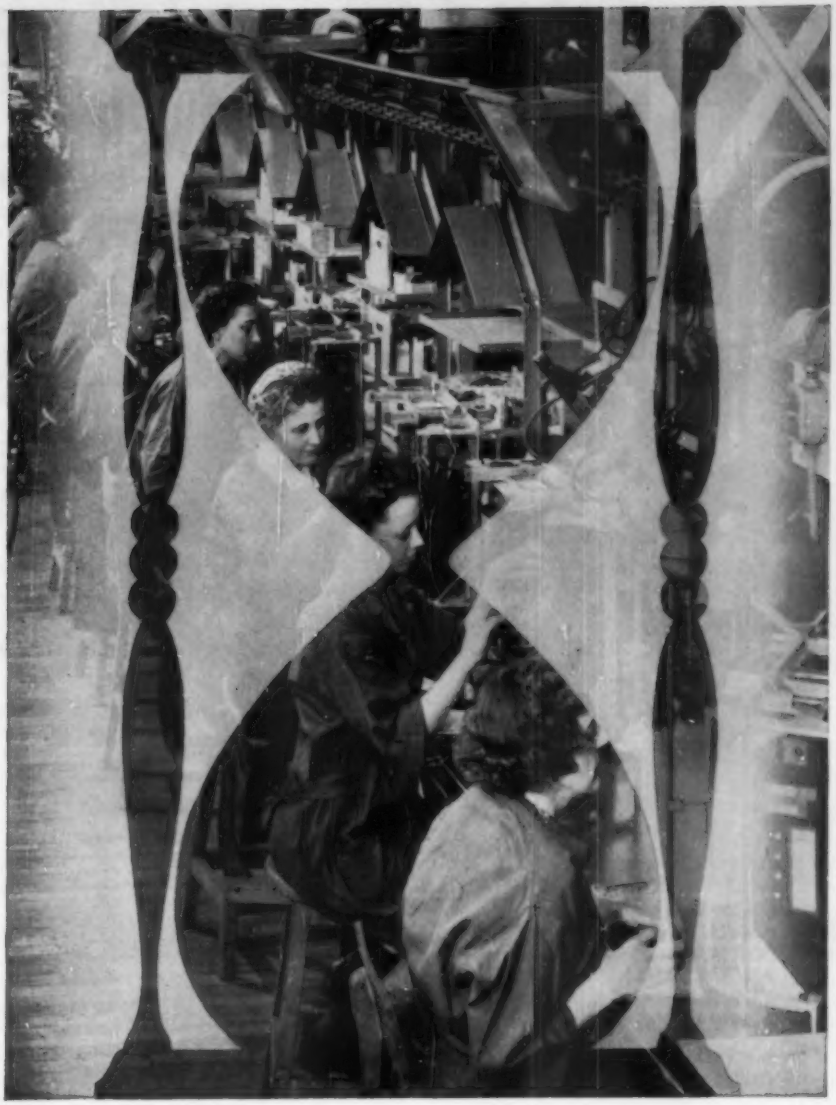
IBM

World's Leading Producer of Electronic Accounting Machines



Time Fighters...





GM GENERAL MOTORS GM GOOD MANAGEMENT

AC QUALITY PRODUCTS

It was a job that couldn't be done. But, AC is proud that it *was* done . . . and done in less than scheduled time.

AC was among the first to be given the job of producing complex electro-mechanical units for the Armed Forces. And from that moment on, a relentless war has been waged against time in every phase of the operation — *research* — *development* — *production.*

Today, the record of AC's defense group speaks for itself. The quality and volume of "A" series Gun-Bomb-Rocket Sights — A-1A Bombing Navigational Computers — T-38 Skysweeper Fire Control Systems bear witness to that organization's efficiency.

If you have a problem in the field of complex, high-precision electro-mechanical devices, perhaps AC can be of assistance. Why not give us a call?

AC SPARK PLUG DIVISION GM GENERAL MOTORS CORPORATION
FLINT, MICHIGAN

DEFENSE PRODUCTS of High Quality at Low Cost DELIVERED ON TIME

DEPENDABLE ROCKET POWER

for U.S. Missile Programs

It may be the prime power plant, the booster, or one or more of the components — but some part of it probably came from Aerojet-General, the nation's leading organization devoted to research, development and production of rocket power.

- **SOLID- AND LIQUID-PROPELLANT ROCKET POWER PLANTS FOR AIRCRAFT AND MISSILE APPLICATIONS**
- **ELECTRONICS AND GUIDANCE**
- **ARCHITECT-ENGINEER SERVICES**
- **EXPLOSIVE ORDNANCE AND WARHEADS**
- **AUXILIARY POWER UNITS AND GAS GENERATORS**
- **UNDERWATER PROPULSION DEVICES**
- **ORDNANCE ROCKETS**

Aerojet-General CORPORATION

A Subsidiary of
The General Tire & Rubber Company

THE GENERAL TIRE

AZUSA, CALIFORNIA
CINCINNATI, OHIO
SACRAMENTO, CALIFORNIA

ATOMIC ENERGY

SUN-POWERED BATTERY

A battery that converts sunlight into usable electric current has been developed by the Bell Telephone Laboratories. In tests the small battery has provided ample current for clear voice communication from a pocket-size FM radio transmitter one hundred feet outside a building to a receiver indoors without the use of an antenna. With an antenna the range is claimed to be at least a half mile.

The battery is simple in construction—10 metal wafers, of specially treated silicon, each 2¼ inches by a ½-inch in size, are placed side by side in a transparent plate, wired together and to terminals from which it can be connected like any other battery to the current-consuming device.

TWO NEW ACCELERATORS

The U.S. Atomic Energy Commission has authorized construction of two heavy particle accelerators—one at Yale University and the other at the University of California Radiation Laboratory—for research of interest to the AEC.

Most particle accelerators constructed to date utilize relatively light particles. The new accelerators, however, will accelerate atomic nuclei ranging from beryllium, which has an atomic weight of 9, to neon, with an atomic weight of 20. The interactions of the heavy nuclei with matter are expected to be of considerable scientific interest.

The accelerator at the University of California will be used primarily in nuclear chemistry studies, such as the possible production and identification of new elements and new isotopes of known elements. The machine at Yale will be used principally in studies of the physics of heavy particle nuclear interactions.

Both machines will be linear accelerators. They will accelerate nuclei to an energy of approximately 10 million electron volts for each particle in the nucleus. This will be sufficient to allow the nuclei to interact with even the heaviest known elements.

The AEC will contribute $1,200,000 for the construction of each accelerator.

IRRADIATION FACILITIES

The Atomic Energy Commission has made available to the public on a limited basis the specialized facilities of the Materials Testing Reactor at the National Reactor Testing Station in Idaho.

The MTR, developed and built under the AEC's Reactor Development Divi-

A Brief History of Shortwave

(It's amazing how much of it has been written by Zenith)

If the history of shortwave in this country were put into a book, you'd run across the name of Zenith on practically every page. The latest chapter is being written in the outposts of the U. S. Services all over the world. There, the Zenith Super Deluxe TRANS-OCEANIC portable is doing the valiant morale job of keeping servicemen in constant touch with home. This is the same...

(2) famous Zenith shortwave that has been carried by diplomats, explorers, world celebrities on missions all over the globe. Its list of owners reads like Who's Who. For 13 years it has worked faithfully under very extreme conditions of cold and tropic humidity . . . on ships, trains and planes. The original . . .

(3) Zenith TRANS-OCEANIC portable introduced just before World War II, was the realization of Zenith Commander McDonald's insistence on a practical portable that would handle shortwave as easily as standard broadcast. It took Zenith's engineers over two years to develop such a set and . . .

(4) the production of the now famous Zenith TRANS-OCEANIC portable was begun in 1941. This was only after Commander Donald B. MacMillan, noted Arctic explorer, reported from off the coast of Greenland that never had a radio worked so well under Arctic conditions as the battery operated shortwave set Zenith had supplied him. Even more dramatic . . .

(5) was the year in the early 20's when Commander McDonald persuaded the Navy, bound for exercises off the coast of Australia, to take along a shortwave transmitter and receiver aboard the battleship "Seattle." When all standard radio failed, this equipment maintained direct contact with the U. S. That was the turning point in the Government's recognition of shortwave.

Zenith leadership in the development of shortwave has resulted from 35 years of devotion to engineering and manufacturing radionics products exclusively. The know-how born of this experience has been at the constant service of the Government . . . as, for instance, in the manufacture of the proximity fuses which played a major role in World War II.

ZENITH

The royalty of RADIO and TELEVISION®

Backed by 35 years of Experience in Radionics Exclusively

ALSO MAKERS OF FINE HEARING AIDS

Zenith Radio Corporation, Chicago 39, Illinois

COPR. 1954

sion and supervised by the Commission's Idaho Operations Office, is a unique research tool because it is a high-intensity neutron source. It can produce isotopes of higher specific radioactivity than the Argonne, Brookhaven, and Oak Ridge reactors where irradiation services are also performed for the public.

The MTR was designed and constructed as a pioneer step in the development of high-neutron-intensity reactors and with the primary purpose of providing facilities to test materials which would be used in future reactor construction. It continues to serve this purpose.

A part of the reactor space made available to the public on a continuing basis will provide a higher neutron intensity than is available at present in other reactors. Even portions of the area of the reactor's greatest neutron intensity, which is used primarily for AEC projects, may be available from time to time.

Requirements of the atomic-energy program will take precedence over non-Government experiments in all areas of the reactor. Because of security considerations, experiments requested by the public will be performed by the contractor who operates the reactor for the Commission.

Charges will be made for public irradiations in the MTR. These charges, based on all costs involved, including depreciation, overhead, and operating expenses, are considered to be sufficiently low to bring the service within the means of qualified research organizations. Applications should be filed with the U.S. Atomic Energy Commission, Isotopes Division, Oak Ridge, Tenn.

The Isotopes Division issues authorizations to persons or firms who are equipped to handle radioactivity in a safe manner. The contractor operating the MTR, namely, Phillips Petroleum Company, Idaho Falls, Idaho, should be contacted directly for information concerning technical questions relating to irradiation services, scheduling, price lists, and arrangements for obtaining these services.

NEW CANCER AID

Development of a new isotope material that may become an important factor in cancer research was recently announced by Arthur F. Rupp, Director of the Operations Division of Oak Ridge National Laboratory. For the first time in scientific history, large quantities of the radioisotope cesium 137 have been separated and compressed into pellets.

The cesium 137, which is the most important long-lived gamma-ray-emitting isotope found in spent reactor fuel, was chemically separated from fission products available at the laboratory. The first cesium pellets will be used as a radiation source in a new teletherapy unit being

Save Up to 80% on Fastening Costs with the REMINGTON STUD DRIVER

"Cuts my conduit anchoring cost by an average of 74%"—writes one electrician about his Remington Stud Driver, and it's a typical report. With a speed of up to 5 studs per minute, this powder-actuated tool is bringing new economy to the job . . . new opportunities for electrical contractors.

Many maintenance men are finding they can speed up installations, get more jobs done with the Remington Stud Driver. Others tell us that the tool's light weight—6 lbs.—makes overhead work a lot easier. All are agreed that you can't beat the Stud Driver for setting studs in concrete and steel.

What's your fastening job? Whether you're fastening eye bolts for stringing wires or conduit clips to concrete, you'll save money with the Remington Stud Driver. For further information on how this amazing tool can help solve your fastening problems, mail the coupon below.

"If It's Remington—It's Right!"

Remington (DUPONT)

Listed and Approved by Underwriters' Laboratories, Inc.

QUESTIONS YOU ARE ASKING

QUESTION

Where can I get information about the guards that many maintenance men have been using for special applications?

ANSWER

Just send the coupon below, we'll be glad to supply you with a description of all the guards and their uses.

MAIL THIS COUPON TODAY

Industrial Sales Div., Dept. O-7
Remington Arms Co., Inc.
Bridgeport 2, Conn.

Please send me a *free* copy of the new booklet showing how I can cut my fastening costs.

*Name*_____

*Position*_____

*Firm*_____

*Address*_____

*City*_____ *State*_____

PITTSBURGH NU-CHROMSEAL TAPES

Provide

1. Better Insulation

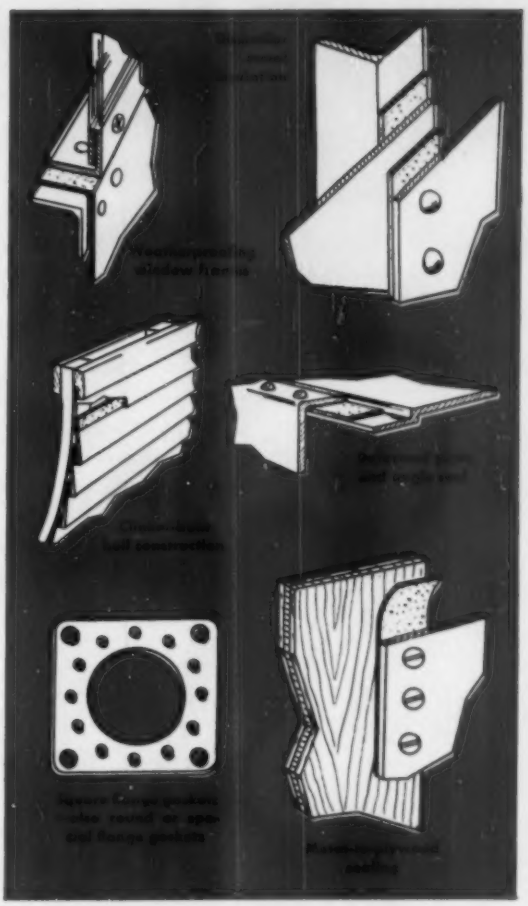
2. Weather- and Waterproofing

3. Resistance to Anti-Galvanic Corrosion

DESIGN AND PRODUCTION executives in many fields are specifying Pittsburgh's Nu-Chromseal Tape to seal lap joints or butt seams in metal, wood or fiber where rivets, bolts and screws are used.

Nu-Chromseal Tape is a solid, pliable compound produced in a film of fixed thickness and width. It can be used for weatherproofing of roof and side panels of motor buses; for caulking around fender-to-body seams of motor cars; in various seams of marine craft. It can be used to seal water, gasoline and oil storage tanks in marine craft. It can also serve as a galvanic insulator between dissimilar metals to prevent corrosion. Still another use is to prevent chafing and squeaking between wood or metal members.

Nu-Chromseal is gently adhesive, so it can be readily applied under rapid production conditions. Its pliable consistency permits easy tailoring of excess material. This tape can also be applied where baking temperatures run as high as 375°F., without bleeding or materially changing in characteristics.



Pittsburgh Also Offers WELDSEAL and FABSEAL Tapes

- **Weldseal Tape protects** spot-welded and hot-riveted assemblies from corrosion by sealing seams against moisture.
- **Fabseal Tape** is an impregnated fabric that forms a complete seal between wood, metal or fiber members.
- **Samples of these tapes** will be furnished free, on request, for experimental work. Our engineers will gladly consult with you without fee or obligation.

PITTSBURGH PLATE GLASS CO.

Factories: Milwaukee, Wis.; Newark, N. J.; Springdale, Pa.; Atlanta, Ga.; Houston, Texas; Torrance, Calif.; Portland, Ore. Ditzler Color Div., Detroit, Michigan. Thresher Paint & Varnish Division, Dayton, Ohio. Forbes Finishes Division, Cleveland, Ohio. M. B. Suydam Div., Pittsburgh, Pa.

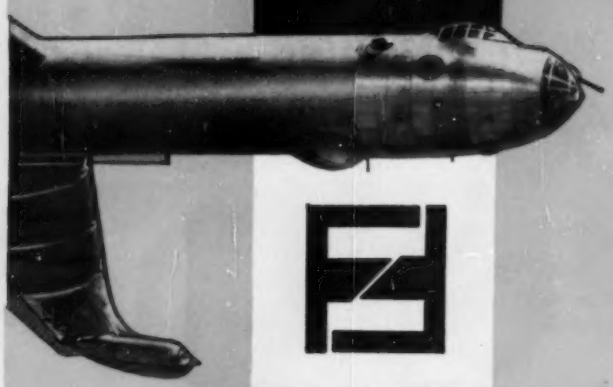
PITTSBURGH PAINTS

PAINTS • GLASS • CHEMICALS • BRUSHES • PLASTICS • FIBER GLASS

PITTSBURGH PLATE GLASS COMPANY

IN CANADA: CANADIAN PITTSBURGH INDUSTRIES LIMITED

emphasis on excellence



• Production conscious designers of magnetic cores know the importance of unvarying quality. That's why they prefer laminations produced to exact specifications by MAGNETIC METALS COMPANY. A combination of highly skilled personnel, exclusive annealing techniques and most modern plant equipment is the basis on which this company has established its reputation as foremost mass producer of magnetic core parts for electronic equipment.

MAGNETIC METALS COMPANY

Soft Iron and Alloy Cores and Shields

21ST & HAYES AVENUE • CAMDEN 1, N.J.

OFFICIAL DEPT OF DEFENSE PHOTO

prepared for cancer research in the Medical Division of the Oak Ridge Institute of Nuclear Studies.

"Large quantities" of high-purity cesium 137 means just these two pellets, each about the diameter of a half dollar, a half-inch thick and weighing a little more than an ounce. The two pellets contain 1,540 curies of radioactivity, equivalent in radiation energy to more than one pound of radium, which at current rates would cost more than $1,000,000.

Cesium 137 has great potentialities for applications where X-ray machines, radium, or radioactive cobalt 60 are now commonly used. Although performing essentially the same functions, it offers several advantages over these sources.

One advantage lies in its relatively long lived intensity. Cesium 137 has a half life of 37 years—over 7 times that of cobalt 60 though not nearly so long as radium's almost 1,600 years. Another feature is the favorable range of its energy. Its gamma-radiation energy is 0.66 million electron volts (Mev), as compared with 1.2 Mev for cobalt 60. This lower energy is sufficient for successful deep therapy, yet it requires less shielding than a cobalt source.

REACTOR STUDY APPROVED

The Atomic Energy Commission recently entered into an agreement with five utility companies of the Pacific Northwest under which the companies will study the feasibility of designing and constructing a nuclear reactor for the production of electric power.

This study is the first to be undertaken by concerns in the Northwest where there is a growing demand for new sources of power. This project brings to thirteen the nuclear power studies being made under the Commission's Industrial Participation Program.

The utility companies taking part in this project are the Montana Power Company, Butte, Mont.; the Washington Water Power Company, Spokane, Wash.; the Pacific Power and Light Company, Portland, Oreg.; the Portland General Electric Company, Portland, Oreg.; and the Mountain States Power Company, Albany, Oreg.

As in other study agreements made with the AEC, the group will survey the Commission's reactor development activities to determine the engineering feasibility of designing, constructing, and operating a nuclear power reactor, the economic aspects of such a reactor project, and the research and development work that would be involved. The study will run for one year at the conclusion of which the group will report its findings to the AEC and make recommendations on how the project might be carried out. All costs of the study will be borne by the companies.

AMERICAN ORDNANCE ASSOCIATION

Founded 1919

A patriotic, educational, scientific, nonpolitical, and nonprofit-making organization of American citizens dedicated to scientific and industrial preparedness for the common defense

OFFICERS

President

Levin H. Campbell, Jr., Automotive Safety Foundation, Washington, D.C.

Vice-Presidents

Herbert A. Gidney, Gulf Oil Corporation, Pittsburgh, Pa.
Harvey C. Knowles, Procter & Gamble Company, Cincinnati, Ohio
Louis Polk, Sheffield Corporation, Dayton, Ohio
Robert L. Biggers, Fargo Division, Chrysler Corporation, Detroit, Mich.

Regional Vice-Presidents

John S. Pfeil, Stone & Webster, Inc., Boston, Mass.
Daniel J. Martin, Hughes Tool Company, Houston, Tex.
K. T. Norris, Norris-Thermador Corporation, Los Angeles, Calif.
John M. Olin, Olin Industries, Inc., East Alton, Ill.
Fairman B. Lee, Fairman B. Lee Company, Seattle, Wash.
Dean Witter, Dean Witter & Company, San Francisco, Calif.
William J. Rushton, Protective Life Insurance Company, Birmingham, Ala.
Myron J. Hayes, Eastman Kodak Company, Rochester, N.Y.
Charles M. White, Republic Steel Corporation, Cleveland, Ohio
W. G. Swartchild, Jr., Swartchild & Company, Chicago, Ill.

General Chairman, Technical Divisions and Committees

Henry N. Marsh, Hercules Powder Company, Wilmington, Del.

Treasurer

James D. McIntyre, Washington, D.C.

Counsel

John Ross Delafield, Delafield, Marsh and Hope, New York, N.Y.

Executive Vice-President

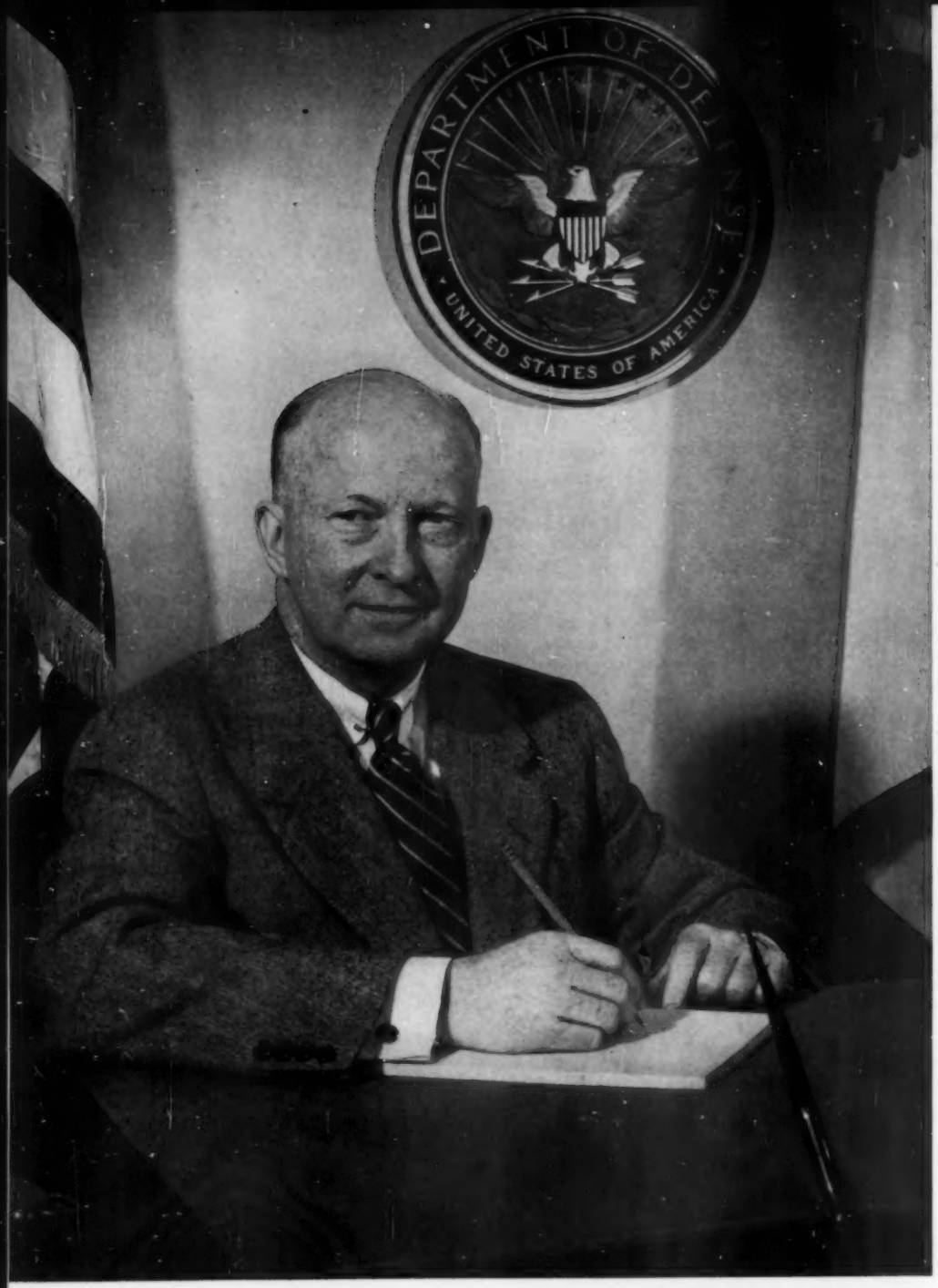
Leo A. Codd, Washington, D.C.

Secretary

Florence G. Ferriter, Washington, D.C.

DIRECTORS

Robert L. Biggers, Fargo Division, Chrysler Corporation, Detroit, Mich.
Levin H. Campbell, Jr., Automotive Safety Foundation, Washington, D.C.
Donald F. Carpenter, Wilmington, Del.
Henry L. Clark, General Motors Corporation, South Gate, Calif.
W. W. Coleman, Bucyrus-Erie Company, Milwaukee, Wis.
C. Stewart Comeaux, Oklawaha, Fla.
B. F. Fairless, U.S. Steel Corporation, Pittsburgh, Pa.
Herbert A. Gidney, Gulf Oil Corporation, Pittsburgh, Pa.
R. E. Gillmor, Sperry Corporation, New York, N.Y.
E. R. Godfrey, General Motors Corporation, Detroit, Mich.
S. C. Hope, Esso Standard Oil Company, New York, N.Y.
George F. Hussey, Jr., American Standards Association, New York, N.Y.
C. Jared Ingersoll, Muskogee Company, Philadelphia, Pa.
K. T. Keller, Chrysler Corporation, Detroit, Mich.
Harvey C. Knowles, Procter & Gamble Company, Cincinnati, Ohio
Ben Moreell, Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
F. H. Payne, Springfield, Mass.
Louis Polk, Sheffield Corporation, Dayton, Ohio
John Slezak, Turner Brass Works, Sycamore, Ill. (*on leave*)
J. E. Trainer, Firestone Tire & Rubber Company, Akron, Ohio
Charles D. Wiman, Deere & Company, Moline, Ill.



GEORGE H. RODERICK

Assistant Secretary of the Army (Financial Management)

Finances and the Army

Effective direction will achieve many substantial economies

THE Departments of the Army, Navy, and Air Force are each comparable in the size and complexity of their operations to the largest of the executive departments of the Federal Government.

Under the pattern of administration established by the National Security Act of 1947, no specific functions were assigned by statute to the two Assistant Secretaries of the Army and Air Force.

One of the Assistant Secretaries of the Navy was assigned the specific duty of aiding the Secretary of the Navy in fostering naval aëronautics.

Under the present Administration the Assistant Secretaries are utilized as administrative and supervisory specialists in functional areas. With only two Assistant Secretaries in each of the military departments, it has been necessary to assign a multiplicity of functions to each.

IT is said by some experts who have studied the question that a wide distribution of functions impairs the effectiveness of civilian direction.

Hence there is a prevalent belief that a logical completion of the established administrative pattern requires that the Assistant Secretary charged with the responsibility for financial management in each of the military departments be so designated by statute.

The Secretary of the military department would have the authority to designate this Assistant Secretary to perform the duties of the comptroller of the department.

It is still further held that increased efficiency in the administration and operation of the military departments, and of the Department of Defense as a whole, would result.

George Holmes Roderick, Assistant Secretary of the Army (Financial Management) was born in Indianapolis in 1900 and was graduated from the University of Michigan in 1921 with a bachelor of science degree in mechanical engineering.

Mr. Roderick became associated with the American Seating Company in Grand Rapids in 1923 and served in various important capacities with that organization including manager of the war products division. At the time of his present appointment he was vice-president and a director of the company.

In other corporate activities, Mr. Roderick served as a director of the Newport Steel Corporation of Newport, Ky., and as a director of the Michigan National Bank in Grand Rapids.

He has been active in the American Ordnance Association for many years, serving as cofounder and director of the Western Michigan Chapter, and director and vice-president of the Michigan Post in Detroit.

In 1953 Mr. Roderick was presented with a citation by the College of Engineering of the University of Michigan for "outstanding contribution to the war effort by conversion of an excellently managed peacetime manufacturing concern."

President Eisenhower nominated Mr. Roderick to be Assistant Secretary of the Army (Financial Management) on January 20, 1954. His nomination was confirmed by the Senate on February 5th, and he took the oath of office four days later.

The move to provide for two additional Assistant Secretaries for each of the three military departments, and specifying that one of the Assistant Secretaries in each department be designated Assistant Secretary for Financial Management, may seem to some observers merely another in a long series of reorganizations that are always eulogized as calling for no additional fiscal expenditures.

In the present instance the claim is made that the financial burden of the six additional salaries for six additional Assistant Secretaries (two each for Army, Navy, and Air) will be more than offset by economies resulting from more effective organization of the three military departments along functional lines.

MANY years ago an old-timer—now very, very high in the Federal service—said that many brilliant men had come to Washington, both as Secretary of War and as Chief of Staff, with the sincere purpose of reorganizing completely the outmoded bureaucracy so as to achieve economy and efficiency of operation.

He added that fighting the existing organization was like punching a feather pillow. When you pushed it in here, it popped out there, and by sheer size and inertia it eventually wore down all would-be reformers.

Be that as it may—and there is profound truth in that observation—the United States is confronted with the major responsibility of making the defense dollar provide a maximum of service to the national defense.

An outstanding businessman is probably best qualified in the complex field of fiscal management because of long and varied experience in the highly cost-conscious commercial activities of private enterprise.

We wish the new Assistant Secretary of the Army (Financial Management) lots of success as an alert and prudent guardian of the weary taxpayer's money. And members of the Ordnance fraternity who have known Assistant Secretary Roderick and his industrial achievements know that the wish has excellent chances of fulfillment.

Unity for Survival

A combined effort for preparedness is the greatest deterrent to aggression but we must first have national unity before we can hope to attain national security

Lieut. Gen. Emmett O'Donnell, Jr., U.S.A.F.

THE United States, with its tremendous capacity to mobilize industry and manpower, has been charged by the free world to lead in halting the Soviets in their designs on that world. We have accepted the charge. Until the day arrives when the whole of human kind adopts the golden rule as a guiding light, the strength of this nation will determine the extent of world freedom.

Our position as the dominant power will brook no compromise with our global responsibilities—the responsibilities commensurate with the preservation of human rights and dignity.

TO meet these responsibilities we must be prepared for any contingency of warfare. Our national defenses have taken on a new character in the strategic concepts. We have recognized and adjusted to another step in the development of active war—a war which at any time may be thrust upon us.

We have long recognized four important steps in the development of an armed conflict—diplomacy, economics, psychology, and military strategy. To the development of these steps we have in the past geared mobilization of industry and manpower. They allowed us the luxury of time afforded by the expanse of two great oceans and other great armed forces on the globe.

Now we are faced with another step, another consideration in the development of war—total exploitation of the knowledge and resources of modern science. Call it technological expansion. Although the technological factor has been recognized since man first hurled a stone at an adversary, it is particularly true in our day that technology has become the decisive factor in war.

On the exploitation of modern science rests our hopes for final peace. Technology will give us the superior weapons that demand the respect of aggressor nations.

It is to our interest to consider our own military stature in the light of international affairs and technological position. Needless to say, air power is a most important factor in this consideration.

Faced with strained relations with the Communist world and the subsequent threat to our own security, the United States has made repeated overtures to the free nations of the world to concert their efforts on mutual defense pacts. These are agreements to work in one accord for the preservation of the dignity of man.

In this we have met with varying degrees of success that only posterity will be able to evaluate fully. However, we well appreciate the contribution our allies have made, and have signified they will make, in the maintenance of the free world.

The alliances are, significantly, a mutual understanding built on the premise of good faith and moral integrity, virtues that the Soviets facetiously ridiculed by bidding to join in the effort.

The world should take notice that, militarily, there is a great different between the arrangement of our "free world éntente" and the Soviet sphere of influence. We invite, not coerce; aid, not exploit; coöperate, not dictate. We recognize no ally as a buffer state—as a dumping ground of devastating nuclear weapons.

Unfortunately for the success of this free world éntente, too many nations of this globe, whose economy and resources preclude their keeping pace with the demands of a technical war, are uttering sighs of resignation before the blandishments of the Soviet sabre.

PROPAGANDA and fear, prime weapons of the Soviet world, are already wreaking havoc with the moral stamina of Europe and Asia.

In this day when the world, in effect, is bipolar—dominated by two giant powers who face each other across the earth—the stakes are too high for our Nation to abide by vague assurances and nebulous responses. We have contributed American lives and national wealth to the end that we shall suffer no encroachments upon our liberty. We find unacceptable any compromise or that will make those sacrifices vain.

General O'Donnell is Deputy Chief of Staff for Personnel, U. S. Air Force, Washington, D. C. This article is taken from an address delivered by General O'Donnell before the Thirty-sixth Annual Meeting of the A.O.A. at Fort Worth, Tex., May 6, 1954.

The key to the survival of the free world in the face of totalitarian aggression is unity of effort. Our President and other statesmen have worked tirelessly and patiently to achieve this end which is realistically expressed by our mutual defense pacts.

In all, we are committed in some degree to the defense of sixty-four nations. Our obligations extend over fifty-four per cent of the world's land mass and sixty-one per cent of its population.

As to our intentions of carrying out the obligations of the agreement, can we do more than we did in Korea? There, in a so-called "little war" we suffered over 144,000 dead and wounded as compared with 14,000 suffered by fifteen nations of the U.N., excluding Korea itself.

IT should be an affirmation of our firm resolve to contain an aggressor nation—a nation based on a philosophy hostile to all other existing systems and the seat of a secular religion dedicated to conquering the world.

"In unity there is strength,"—unity of purpose, unity of action, and unity of command. Where can we get a better example of that unity than from our own affairs during World War II. Through months, then years, of hostilities the allies resolved their divergencies of views on the conduct of the war and under unity of command and action victory was realized. But while it was being achieved good men were losing their lives.

We must regain and preserve unity in this century of total war. I say *total* war, for with the speed of technological expansion, the uses of propaganda, and the magnitude of the stakes, war involving major powers can only be total, animated both by modern science and primitive fury, with the hydrogen bomb and the guerrilla as the extreme manifestation of unlimited violence.

The achievement and maintenance of unity of the free nations is the greatest deterrent to the Kremlin.

We no longer can enjoy the luxury of time in reaching our objectives. I suppose that every generation in recent history has had to adjust itself to scientific developments affecting its habits of thought. But I doubt if mankind has ever been as bewildered by such developments as today, particularly in consideration of the element of time.

If war is thrust upon the United States and other free nations of the world, the most catastrophic and, perhaps decisive, blows will be struck before we can begin to mobilize our resources, industry, and manpower; before we can turn to other nations and say, "Join with us against this aggressor"; before we can take resolute unity of action and command.

We have been overwhelmed with predictions that certain vehicles of war will "soon" be atomic-powered; that manless, automatic supermissiles will "soon" dominate the earth while orbiting platforms dominate outer space.

Or, perhaps more modestly, it is predicted that some new kind of conventional projectile or some vehicle will "soon" make everything else out of date.

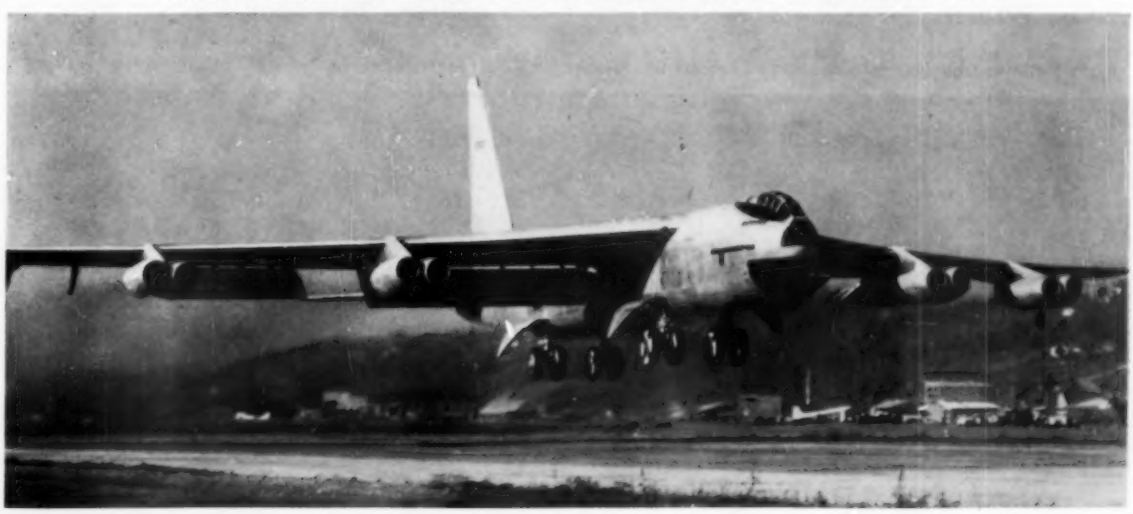
I do not mean to imply that fulfillment of any of these plans is impossible or even improbable. Allow me, however, to point out that they all contain a time equation that is scarcely resolved by the free use of the word "soon."

There is no question in my mind that had we framed our foreign policy and national security with such phrases as "in the near future," "in the not-too-distant future," and "just over the horizon," the sphere of Soviet domination would be greater if not all-inclusive today.

THE planes and equipment of tomorrow did not contain the hostilities in Korea. The missiles and bombs "soon" to be produced are not limiting the Communist action in Indo-China.

Rather it is today's striking power of our strategic and tactical aircraft alerted for the mission of massive retaliation and our air-defense units on constant vigilance day and night to strike the enemy from the skies that

The 8-jet, swept-wing Boeing XB-52 takes to the air during flight tests. The new "Stratofortress" is equipped with tandem landing gear and will be utilized as a heavy bomber (Air Force photo).



restrains the enemy from a total assault.

Consequently, as a substitute for or prelude to total war we have become engaged in little wars in which we can ill afford prolonged involvement.

The United States now has the capability of striking decisively at the root of the Communist evil. The industrial capacity of the free world to support its combatants towers over that of the Soviet Union and its satellites.

We overshadow them in productivity and technological advances. We have better weapons, greater air power, and more to come. We have the spiritual strength which is the heritage and greatest resource of free people.

We also have a conscience and respect for human lives that demands we exhaust every honorable means to avert war; that demands we not take the initiative as long as there is hope that the conflagration can be avoided.

WHY then does the free world falter and hesitate to concert its efforts in a unified move against Communist aggressors? They surely respect our possession of nuclear devices which, coupled with means of strategic and tactical delivery, gives us the superiority in striking power.

Among other things, the free nations are looking for us to assume leadership in the free world éntente by precept and example on the premise that national unanimity is prerequisite to international unity.

We must, at all cost, preclude losing sight of our national objectives by the infringement of one field of interest on another. A technological war is a war of specialization not only of men and machines but of thought as well. National unity is the confederation of ideals, each an entity of itself and a composite of the whole.

When we have each specialist making his contribution with a reasonable hope of freedom from interference from the layman, we can hope for a proper balance with one another, and we can hope for a satisfactory condition of national security.

Our central problem as a nation is so to conduct our affairs that our national security and all its constitutional elements are maintained intact for the benefit and security of the people.

Only when we achieve national unity can we attain national security. Only when we gain that can we expect the nations of the free world to concert their effort against the common threat to our mutual security.

Because of the equation of time in a technological war we should now be aspiring to maintain that unity, not aspiring to achieve it. Consider now with me our proximity to a total war. Diplomatically, we are engaged in a cold war which has been manifest in economic aid to our family of nations and blockade of our enemy.

Psychologically, the Soviet professional apologists, by lies and deceit, justify to the Communist world any overt hostile action they choose to take. Military forces are employed in Korea, in Indo-China, and in many other global areas. The whole world is poised awaiting the Sarajeno of World War III.

BUT because we, the American people, respect the dignity of man, which would be violated in the havoc of a total war, because we hold that life is paramount over other considerations, we are holding our bomber and fighter forces, our Army and Navy, in abeyance, yet in a constant state of vigilance ready to defend if necessary our way of life.

It is an historical fact that war has been at least as common as peace, both for individuals and countries. As old orders change, as alliances and concerts are made, so, too, the policies of nations change.

We, the people of the United States, must come to regard our military establishment as an integral part of our governmental structure. While the magnitude of our forces will necessarily be measured by the state of world affairs, peacetime strength should be adequate and ready to restrain any conquest-minded nation from pursuing its tyrannical objectives.

Furthermore, technological expansion has intricately interlocked the affairs of our Nation with the rest of the world. Isolation is a proposition of the past. Powers have been broken. Empires are gone. America must adjust to its moral and material responsibilities; she must remain the image of freedom and symbol of liberty.

From the retractable launching pod carried beneath the fuselage, an F-86D Sabrejet fires its 2.75-inch "Mighty Mouse" rockets.

The Aircraft Industry

Some of the vital responsibilities and important problems in producing airplanes for the national defense in quantity and on schedule despite design changes and vast complexity

August C. Esenwein

THOSE of us who have watched aviation's dreams come true—the ideas and dreams surrounding the half century which is aviation's total existence—cannot help being impressed with the successes which have been achieved. Aviation has been so successful, in fact, that, together with other branches of modern science, it has revolutionized man's environment.

We dwell in a smaller world by the scale of clocks; we are more accessible to our friends, and more vulnerable to our enemies; distances have lost significance; geographic barriers are eliminated.

Many of us naïvely thought, when the art of flying was very young, that aviation would bring countries closer together in peaceful understanding. We assumed that easy contact would simplify diplomacy and decrease war. Today we know that the historical significance of aviation has been primarily military and destructive.

AVIATION is having its greatest effect in the balance of power of nations and the factors of survival, while diplomatic relationships are floundering in this strange new framework of power, space, and time.

In America in recent years we have perforce spent an alarming amount of energy and thought and money on war. In this atomic age we find ourselves in the position, encountered so often through the ages, of having to rely on arms to maintain peace and to protect the way of life we believe in.

Our military posture and the balance of military forces upon which it rests appear to be molded by a national policy of promising instant and suicidal retaliation to any potential aggressor. Such retaliation—the dumping of A- and H-bombs on selected targets—to be instantly effective requires a tremendous bomber force in being with trained and able crews "at the ready."

Mr. Esenwein, vice-president of Consolidated Vultee Aircraft Corporation, delivered this address at the Thirty-sixth Annual Meeting of the American Ordnance Association, Fort Worth, Tex., May 6, 1954.

None can gainsay the rôle into which aviation—or more correctly in military parlance, air power—has been cast through forces of its own evolution.

Now, let's examine air power—effective air power—for a moment. Isn't it a partnership—or perhaps better, a marriage—of certain elements of the armed forces with the aviation industry? The complete interdependence of the one with the other—a point we could belabor for hours—resembles that of a couple approaching their golden wedding anniversary. The military and the industry are indeed approaching their golden wedding anniversary, for the union took place on August 2, 1909, when the Wright brothers sold the Signal Corps its first aërial weapons system, then known as a "flying machine."

One must admit that this alliance has on the whole been a most successful one. The progeny produced over the last 45 years has been numerous, lively, and effective—the B-17's, the B-24's, the fighters, the transports, and many, many others, not failing to mention the B-36.

Sometimes the partners, as is the case in married life, have had odd thoughts about each other. The armed forces, if they be the husband, have sometimes behaved as though they thought they were married to a very ugly wife. Industry, the wifely type of producer, has ofttimes nagged the other partner for all sorts of shortcomings, some real, many imagined.

BUT, seriously, air power *is* an alliance of the military and the industry. The strength of the whole is no better than the strength of its component parts. Sometimes it is even less, if one of the partners withholds his utmost support from the other, whether inadvertently or not.

If you accept the importance of air power, you cannot then fail to accept the importance of a strong and healthy aircraft industry. And this importance directly influences our national well-being.

Speaking as one in the aircraft industry, what are our responsibilities in being a good and staunch partner of the air-power team? I will enumerate what I consider to be a few of the more important ones:

1. We must accept responsibility for translating military requirements into the best weapons systems that the state of the art, human ingenuity, and a strong measure of common sense can

devise. This is technical integrity.

2. We have a responsibility in time. Our weapons systems must be fashionable to the era of use. Firecrackers aren't much good on the *fifth* of July.

3. We must have a conscience in money matters and costs. Bankruptcy is only another name for defeat—speaking nationally.

4. We have an obligation to be diligent and honorable with our partners in air power. We must strive always to acknowledge the bad as well as the good and not to deal in overoptimism.

5. We have an obligation to view our partner's doings with a healthy skepticism, for this, working either way, can serve to prevent serious and costly errors.

6. We, in industry, must remain seriously competitive among ourselves. I think this is one of the major premiums that must be paid to insure progress.

7. Our products must be of superb quality, both in execution and design. Not at the disregard of cost, mind you, but modulated to include this factor.

8. The aircraft industry must realize that it is a feast-or-famine type of business. We have seen the aircraft industry go completely to pot following two world wars. And however fatal the results may be, there is every indication that the industry will once more be placed on short rations if an uneasy peace should again settle over the world. True, better planning in the highest councils of our Government can ameliorate this feast-or-famine condition but probably cannot eliminate it entirely.

OUR destinies and those of the Department of Defense are identical. More than ninety per cent of the industry's business comes from this establishment. This makes us much more the creatures than the masters of world political and economic factors. I suggest to some of my industry confreres that they accept this fact and include it in their planning. Wishful thinking to the contrary destroys the flexibility of thought and deed so vital to conducting a sound operation.

I could enumerate another dozen responsibilities of the aircraft industry: responsibility to labor, responsibility to capital investors, responsibility to small business, responsibility to the community in which it resides, and responsibility for good planning, good management, and employee safety.

The XB-46, an experimental high-speed bomber produced by Consolidated Vultee, is shown undergoing flight tests at Muroc AFB, Calif. (Air Force photo).

But in my mind none of these is equal in importance to the responsibility we share, in whatever part, for the Nation's security.

The problems we encounter daily at Convair-Fort Worth are largely those encountered by any other plant in the aircraft industry. I would like to discuss some of these problems and hope that they are typical in the industry—with no malice intended!

A great many of our problems are shared in common with manufacturers of other types of merchandise. We have our union problems, including but not limited to negotiations, grievances, and strikes.

We have problems in finance, involving progress payments, audits, vouchering, disallowances, and "is it reasonable?" and "is it necessary?" We argue with our contracting officers every day—and learn in so doing.

WE have daily problems in plant layout, machinery and machine-tool selections, acquisitions, operations, and maintenance.

We have our share of administrative problems pertaining to systems and procedures, personnel, organization, and communications.

We are part of a multidivision corporation and as such have multiple daily relations with persons many miles removed from Forth Worth in matters of policy and operations.

These problems are not unique to the aircraft business, but we do have problems that are unique.

For example, the design of our products is inordinately complex because, as a general rule, complexity increases as performance increases. Apply that statement to the fact that, just since World War II, aircraft speeds have increased three times and airplane altitudes have doubled, and you will get a good idea of the complexity involved.

WE are continually pushing the frontiers of knowledge and know-how in an unusual number of areas. There are few inhibitions about trying new things or new ways. We place a premium on ingenuity and continuing improvement.

Backing a design and release system of this nature with a production organization dedicated to quality products, manufactured on schedule, and within budgeted costs is nice work—and you get it all the time!

Change is ever present in end product, major assembly, installation, and detail. Handling changes expeditiously is a major challenge. Opportunities for costly mistakes abound.

Organizationally, one is continually torn between the conflicting demands of a project system and a group system because of the interplay between multiple program demands. Convair has

eighty-nine programs in simultaneous execution at Fort Worth.

Tooling, and by this I mean production tooling as distinct from general-purpose machine tooling, is unusually complex. Rate of change of design nearly always precludes the adoption of the type of tooling found in the automotive trades. A battle is continually raging around the elements of initial cost versus generated production cost versus probable obsolescence factors.

Another of the larger problems we face is one of timing. Our partners in air power maintain fairly big establishments themselves. They have their problems, too. As a result, it is occasionally difficult to secure timely decisions, authorities, and funding, to say nothing of Government-furnished aircraft equipment.

Communication with our partners is also sometimes a headache. Timeliness and accuracy in communications are problems at which both air-power partners ought to take a good long look, I feel.

I WOULD fail to mention one of our unique problems if I passed over control of work-in-process inventory. If you multiply the number of pieces per airplane to be controlled (184,000 in a B-36) by an indenture frequency of 7 in many cases, and the product of this by scheduling and flow factors, and this product by a cost-control factor, and the whole by a quality-control factor, then you realize the magnitude of this problem.

Then there is the problem of conducting a manufacturing operation on the same premises simultaneously with an overhaul and modernization program. Manufacturing and overhauling mix about as well as oil and water. Divergent skills, standards, planning, and procedures are involved. What is optimum in a manufacturing cycle, cost-wise and time-wise, is unusable in a maintenance-modernization cycle.

While our problems in the aircraft industry are tough, they can and are being solved—well solved. And in this I am sure I can speak for the industry.

To illustrate what I mean, let me borrow again from Convair-Fort Worth experience, even though in so doing I run the risk of being accused of a little bragging—Texas style. I am using this example to typify what each segment of the industry has been through, to one degree or another.

"Aviation is having its greatest effect in the balance of power of nations and the factors of survival . . . In America in recent years we have perforce spent an alarming amount of energy and thought and money on war. In this atomic age we find ourselves in the position, encountered so often through the ages, of having to rely on arms to maintain peace and to protect the way of life we believe in."

In 1949 we had 15,000 employees at Fort Worth. By 1951 we had climbed to nearly 32,000. Today we are just below 18,000.

During this period of expansion and contraction we delivered more than 200

B-36's; yet we were able to reduce our man-hours from 350,000 per plane to 142,000, to improve quality continually, and to reduce the anticipated unit cost to the Government some 15 per cent despite increasing wage and material costs.

Add to this the fact that during this period we processed so many changes that the first and last B-36's have only twenty per cent of their parts in common. With all this, we delivered every B-36 on schedule during the past 2½ years.

I recite these facts only to prove that the industry can do a job within adverse parameters and within the scope of circumstances that exist.

I know also that comparable performances are being recorded in most aircraft plants today. I think the industry is truly coming of age.

What it takes to do this is a realistic appraisal of the framework in which we operate, a recognition of the fluidity with which we must do business, an acceptance of responsibility by labor, management, and capital, and a strong sense of enthusiasm and dedication on the part of all.

These things will help us overcome some of the problems inherent in this highly interesting, ever-changing aircraft industry. These things will help the American aircraft industry in its efforts to deliver the best military aircraft to the armed forces, the best commercial transports to the world's airlines, and the best business and personal planes to companies and individuals.

And this technological superiority in the air becomes increasingly important in this age of atomic and hydrogen bombs—in this otherwise enlightened age when certain nations respect nothing but force.

THE reward of knowing that *you*—as a small part of this great industry—are helping to preserve the American way of life is a mighty fine one to carry in your heart.

The B-36 intercontinental bomber, pride of the Strategic Air Command.

James L. Walsh Prize Essay Contest

THE officers and directors of the American Ordnance Association announce the annual James L. Walsh Prize Essay Contest for 1954. The cash prize of one thousand dollars was established last year in memory of the late Col. James L. Walsh, one of the founders of the Association and president from 1947 to 1952.

¶ All members of the Association who have not reached their thirtieth birthday at the closing date for entries are eligible to enter the contest. The prize-winning essay will be published in ORDNANCE, and all essays submitted will be considered for publication. Authors of nonprize-winning essays will be paid the usual publication rates for articles published in ORDNANCE. The topic for the 1954 contest will be:

"Industrial Mobilization as a Vital Factor in National Defense"

¶ To be eligible, essays must be submitted on or before October 15, 1954. They must not exceed 3,000 words and must be typewritten, double-spaced, on paper approximately 8½ by 11 inches. They must be submitted in triplicate, each copy complete in itself and firmly bound together.

¶ The name of the competitor must not appear on the essay. Instead, a *nom de plume* must be used. The name and address of the contestant must be typed on plain paper and inserted in a plain sealed envelope on the front of which his *nom de plume* must be written.

¶ Essays with identifying envelope must be mailed in a large sealed envelope marked "Walsh Prize Essay Contest," to the Secretary, American Ordnance Association, 708 Mills Building, Washington 6, D. C.

Ordnance Away!

With trucks, guns, and howitzers being dropped from aircraft in today's airborne tactics, the demand for stronger, lighter equipment and better methods of aërial delivery must be met

Capt. John C. Burney, Jr.

"CLOSE up, men, close up." These were the words used repeatedly by Gen. Thomas (Stonewall) Jackson in his application of General Forrest's homespun maxim concerning getting there first with the most.

Jackson won his place in Valhalla with his masterful conduct of the Valley Campaigns during which "Old Jack" frequently demonstrated his ability to move large bodies of troops swiftly and to concentrate the firepower of his grey-clad Confederates at the crucial spot.

Jackson, and later Guderian, Rommel, Patton, and many others clearly demonstrated that mobility and firepower are essential keys to military success.

The Army's most mobile striking force, the airborne division, is striving to use these keys to maximum advantage but is confronted by a most serious obstacle. Airborne units have great strategic mobility and can be employed rapidly with maximum surprise and shock effect.

However, once the parachutist tumbles from his airplane and must face the enemy, he finds himself hampered by the lack of heavy equipment. He has little battlefield or tactical mobility. He is denied the use of armor and heavy artillery until the ground link-up. The machines which produce mobility and firepower are weighty items; and when the parachute is the only conveyance into an airhead, weight is a crucial factor.

To overcome the lack of heavy equipment and to give airborne units the fire support and ground mobility they sorely need, ordnance is taking to the air. How are heavy vehicles and guns placed in the airhead? What ordnance equipment can be delivered to the paratrooper? What is being done to further satisfy airborne's needs?

The answers to these questions reveal the capabilities and limitations of aërial delivery. An understanding of these capabilities and limitations will greatly facilitate the mutual coöperation necessary in the building of a powerful airborne fighting force.

The effectiveness of airborne units has increased rapidly with each ordnance item that has become airborne. Not long ago, small arms were the only weapons available to the parachutist. But because of the rapid development of cargo aircraft, heavy drop kits, and parachutes, he can now have antitank guns, light artillery, and trucks.

However, equipment weighing more than seven tons is for the exclusive use of the groundbound soldier. What prevents the airborne soldier from having the heavier guns and vehicles he requires?

The airplane is the greatest limitation to heavy drop capabilities. Cargo compartments must be kept to minimum size, increased cargo weights mean reduced radii of action, and the requirement for prepared landing strips dictates parachute delivery.

The glider having proved unsatisfactory during World War II for landing heavy equipment, the need for an airplane designed primarily for the parachute delivery of troops, weapons, and vehicles was apparent. The C-82 and C-119 Flying Boxcars were the first aircraft constructed for this mission. The C-119 increased immeasurably the capabilities of the airborne and is now our standard troop-carrier airplane.

THIS versatile aircraft can carry a payload of over 13,000 pounds a distance of 1,000 miles and return empty without refueling. It can carry loads up to 20,000 pounds for shorter distances. From its 80- by 100-inch boxlike fuselage, equipment weighing as much as 14,000 pounds can be dropped by parachute.

Let's observe the preparation and delivery by parachute of one of the largest airborne items—the 2½-ton truck:

That crew to our front is completing the rigging of the truck. They have placed it on a heavy drop platform and have attached four giant parachutes to suspension points on the truck. Shock pads and wooden crash frames are placed under the vehicle to absorb landing forces. A crane will place the rigged load on the low-bed trailer fitted with wheeled conveyors.

Captain Burney has served as test officer in the Airborne Service Test Division of Board No. 1, Office, Chief of Army Field Forces, Fort Bragg, N. C. He has recently been reassigned to duty in the Far East.

A 2½-ton truck rigged for parachute delivery from a C-119 Flying Boxcar. Note shock absorbers under chassis which hold wheels in suspension.

Let's go out to the airplane and see what preparations have been made there.

The clamshell doors have been removed from the rear of the fuselage and wheeled conveyors have been placed on the floor of the cargo compartment.

HERE comes the load now. The trailer will be backed to the rear of the fuselage, and the load will be winched into the airplane over the conveyors. While the aërial delivery people are lashing the load to the tiedown fittings, we'll get into our parachutes so that we can go along and watch the drop. . .

There's the drop zone and the "T" which marks the desired landing area. To initiate the extraction of the load, the pilot will release a shot bag which will draw out a small pilot parachute.

There goes the pilot parachute now! It draws out a 15-foot extraction parachute which pulls the load from the cargo compartment so quickly that the wheels of the conveyors "sing."

As the truck leaves the airplane, the pull of the extraction parachute is transferred from the load to the main parachutes, and you can see now the picturesque deployment of the four 100-foot canopies.

A disconnect is used to separate the parachutes from the load upon landing to prevent the wind from overturning or dragging the truck.

Now that you have observed the drop from start to finish, you can easily realize how much work and special equipment are required to deliver heavy vehicles and weapons into an airhead.

The first piece of heavy drop equipment mentioned in the parachute delivery of the 2½-ton truck, the heavy drop platform, consists primarily of a wooden framework to which the item to be dropped is lashed. Platforms of three lengths—eleven, fifteen, and twenty-two feet—are currently in use.

A heavy drop kit consists of one of the three platforms plus all other items, except the parachutes, used in aërial delivery. These items include crash frames, shock pads, lashings, and disconnects. One heavy drop kit has been developed for each vehicle and weapon which can now be delivered by parachute.

There are kits for the ¼-, ¾-, and 2½-ton trucks, the M55 multiple machine-gun mount, the 40-mm. antiaircraft gun, the 57- and 76-mm. antitank guns, the 105-mm. howitzer, and the M29 cargo carrier.

These kits vary in weight from 810 pounds for the ¼-ton truck kit to 2,800 pounds for the 2½-ton truck kit. These are large weight penalties when an airplane is the carrier.

Airborne troops use a 6,000-pound-capacity load-bearing platform to drop much of their lighter equipment as well as Class I, III, and V supplies. This platform differs from the heavy drop kits in that the parachute is attached to the platform rather than to the vehicle or weapon.

The platform can be loaded to 10,000 pounds under combat conditions and, with its components, weighs 1,100 pounds. With this versatile apparatus, cargo trailers, water trailers, ammunition trailers, and pack howitzers are dropped to assault troops.

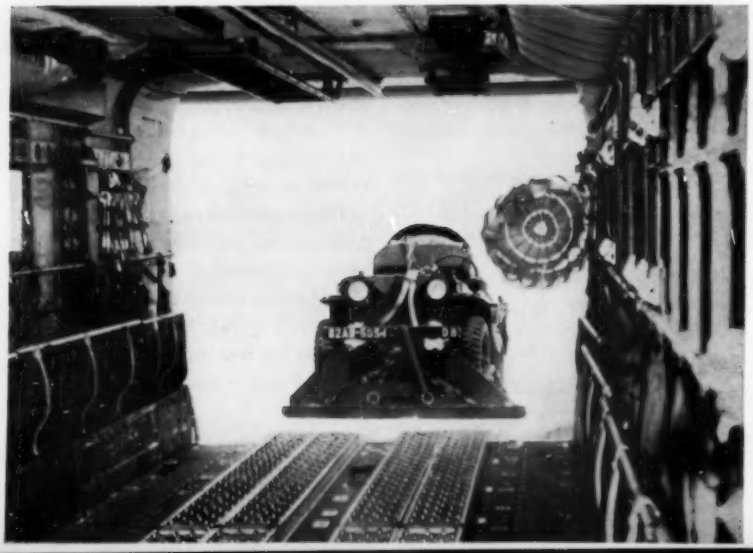
The standard parachute used with the load-bearing platform as well as with the heavy drop kits is the G-11A, our largest cargo parachute. Its canopy is 100 feet in diameter, and the weight of the entire assembly is 250 pounds—another costly weight penalty.

EACH G-11A can be loaded to 3,500 pounds, and therefore the number employed with any vehicle or weapon is determined by the gross weight of the load.

Our parachute system is reliable, but a relatively small mechanism connecting the parachute to the load is not as infallible. Our standard disconnects frequently fail, and much equipment is damaged by being overturned by billowing canopies on windy days. The 45-pound multifinger disconnect frequently damages vehicles because, when actuated, it comes crashing down upon the load instead of being carried off by the released parachutes as would a properly designed disconnect. At present the disconnect is the weakest link in the heavy-drop sequence.

With the airplanes available today,

View from inside a C-119 as the pilot parachute whisks a jeep from the cargo compartment in a "heavy drop." Main parachute can be seen atop the vehicle.



our standard heavy drop system provides the only method of delivering weighty equipment to assault airborne troops. To land equipment by airplane would be preferable, but combat commanders cannot plan on capturing undamaged airfields. Landing zones and strips are not required for parachute drops, for the technique permits accurate delivery in any type of terrain.

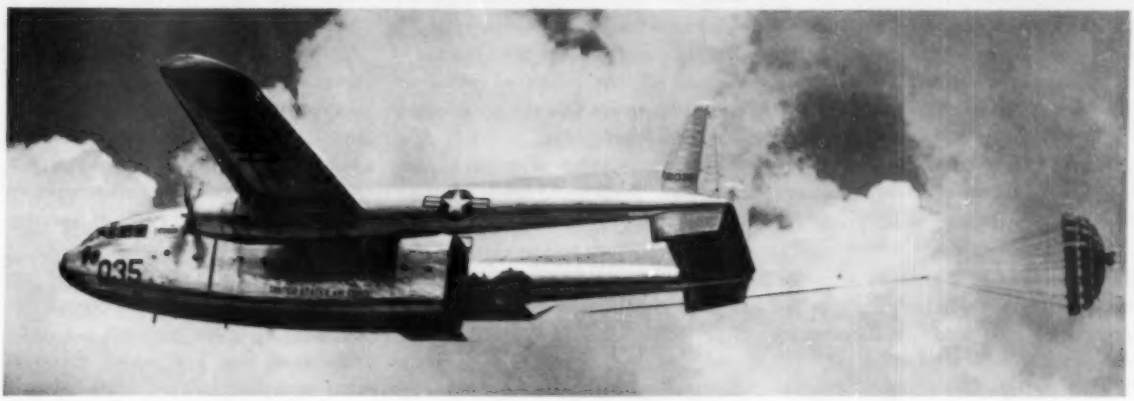
By the use of recently developed equipment and jump techniques, troopers now can jump from the same airplane which drops equipment and can occupy cargo space previously left from the payload of a C-119 when heavier items are delivered by parachute.

Heavy drop techniques are costly in time as well as in weight. Four experienced men require almost half a day to prepare one 2½-ton truck for parachute delivery. The man-hours required to rig the hundreds of trucks and guns that would be dropped in a large-scale airborne operation constitute a bottleneck to staff planners.

And when the equipment reaches the airhead, where every lost moment costs lives, the derigging of loads by combat troops consumes much precious time.

This new platform is load-bearing; the suspension slings of the parachute are attached to the platform rather than to the load. Therefore, one platform will be required for each weight class rather than one kit for each item of equipment. This added flexibility will greatly simplify the preparation for airborne operations.

AIR-BAG platforms should soon be available. A 3,500-pound-capacity stressed platform has been dropped with encouraging results, a 7,000-pound platform is undergoing engineering tests, and a 16,000-pound platform is in the design stage.



Viewed from outside, the jeep looks like this as it leaves the C-119 under the pull of the pilot parachute to begin its long drop.

empty. Thus, maximum utilization can be made of each valuable airplane.

Vehicle drivers and gun crews can jump immediately after their equipment and not risk separation from their trucks and weapons by traveling to the drop zone in different airplanes.

Thanks to an airplane designed for heavy drop, reliable parachutes, and newly perfected techniques, we do have an effective method for supplying trucks, howitzers, and antitank guns to the airborne soldier.

WHEREAS the current aërial delivery method is adequate, there are several disadvantages which must be eliminated. The greatest disadvantage pertains to economy, for the parachute is a most inefficient apparatus. Each G-11A parachute steals 250 pounds from the payload of an airplane. Heavy drop kits, conveyors, and chain-type tiedown devices add heavily to the weight penalty. The use of all this equipment subtracts approximately 4,000 pounds

Loads are frequently damaged by unusually severe landing shocks or as a result of being overturned by parachutes attached to faulty disconnects; and the higher the wind, the greater is the percentage of equipment damaged. Moderately high winds could easily convince a commander to postpone or cancel an airborne operation.

In spite of these disadvantages, the future is encouraging for airborne proponents. Numerous developments in aërial delivery techniques show great promise.

New equipment which will make the present heavy drop system more effective is rapidly coming into being. The simple heavy drop platform may soon be replaced by a new type of platform fitted with air bags which are inflated during descent. Upon landing, the air within the bags is metered out, cushioning landing forces. Little damage to vehicles and weapons should occur with the air-bag type platform.

Equipment used with the platforms is constantly undergoing improvement. A new type of padding which will provide better protection for valuable equipment has recently been developed. Automatic restraint and release devices which will simplify and hasten the extraction of loads from cargo compartments are nearing perfection.

The requirement for a reliable disconnect has been constantly stressed, and designers should soon complete work on models that will make present disconnects appear primitive in comparison.

Experiments are being conducted in the use of multiple parachutes of 64-foot diameter to replace the 100-foot parachute. This arrangement provides greater stability during descent and will reduce damages sustained during overturnings caused by oscillation.

Improvements in tiedown devices, pathfinder aids, and many other of the

scores of tools used to carry and drop heavy equipment are uniting to supply the paratrooper with more and more heavy weapons.

Additional vehicles and weapons are becoming airborne with the development of each new cargo airplane. The C-124 Globemaster can easily carry the M41 tank—a weight of over 50,000 pounds.

A heavy drop system for the C-124 has been devised, and the results of initial tests have been most encouraging. Forty thousand pounds of equipment have been delivered by parachute in several seconds. Equipment is loaded on three platforms, which travel on tracks mounted to the floor of the cargo compartment. As much as 18,000 pounds can be loaded on any platform.

Over the drop zone, a chain drive pulls the platforms to the rear of the cargo compartment where they fall through the loading well. With this system, a howitzer, its prime mover, and thousands of pounds of ammunition can be delivered into an area approximately 300 yards in diameter by one airplane.

Lockheed is constructing an airplane —the C-130—which should prove very satisfactory for heavy air drop. The C-130 should permit the parachute delivery of larger and heavier vehicles and weapons, and the paratrooper should be able to have in the airhead ordnance equipment weighing at least 20,000 pounds. Each step forward in the development of cargo airplanes means a more potent airborne striking force.

OUR Army is not relying solely on parachute delivery to place heavy equipment in an airhead. Since the glider proved unsatisfactory, efforts have been made to develop an effective assault airplane which can land and take off using rough, unprepared fields. The C-122, a converted glider, proved unsatisfactory. Designers then turned to the CG-20 glider, added engines, and finally produced an assault airplane—the C-123—which performed well during flight tests.

The C-123 was designed to carry 16,000 pounds a distance of 1,500 miles and return empty without refueling. Fairchild was recently awarded a contract to construct this assault airplane, but the C-123 has to undergo service tests before it can be considered satisfactory for use in airborne operations.

The helicopter is another type of aircraft which shows great promise. With the helicopter, no weight penalties are incurred by the use of parachutes and heavy drop kits; time-consuming rigging operations will no longer be required; and no equipment should be damaged by rough landings.

But the helicopter is not yet the solution to the heavy drop problem. Payloads are too small, ranges are too short, and the helicopter is too vulnerable to enemy fire. Although emphasis is being placed on the development of a more efficient means of aërial delivery, it appears that the parachute is here for a lengthy stay.

The development of more efficient means of aërial delivery and the standardization of equipment that can be used by the paratrooper as well as by groundbound troops deserves strong emphasis, for airborne warfare will be an essential part of any future war.

"In the production of new weapons and vehicles, ordnance developmental agencies should constantly bear in mind the requirements of airborne troops and the limitations of parachute delivery."

The trend is toward increasing the mobility of our combat units. Swiftly moving, hard-striking combat teams—armor and airborne—are required to defeat a numerically superior enemy. The use of atomic weapons will increase this requirement, for highly mobile troops are the least vulnerable to atomic attack and are best suited to exploit our use of an atomic blast. A German appraisal of the future value of airborne troops states:

"Future wars offer far-reaching possibilities for the employment of airborne operations . . . At the beginning of World War II the strategic employment of armor completely changed the concept of warfare carried over from World War I; it is quite conceivable that, at the beginning of a future war, the employment of large airborne units will play a similar rôle."

To give airborne units the increased mobility and firepower they require, ordnance must play a vital part. Heavy drop capabilities are steadily expanding, thereby increasing the weights and dimensions of vehicles and weapons that can be delivered by parachute.

Ordnance must do its utmost to decrease the weights of standard equipment so that airborne troops in combat will not suffer from a lack of the proper weapons. As many ordnance items as possible must be capable of being delivered into an airhead.

In the production of new weapons and vehicles, ordnance developmental agencies should constantly bear in mind the requirements of airborne troops and the limitations of parachute delivery. Not only weights and dimensions must be considered but also tiedown points, parachute suspension facilities, and ruggedness to sustain landing shocks.

The needs of the parachutist are pressing, and only by a thorough understanding of his problems can Army Ordnance give him added firepower and tactical mobility.

THE maximum coöperation and coördination between ordnance development agencies, service testing units, and the using troops are mandatory. Knowledge of the techniques and equipment used in parachute delivery, advantages and disadvantages of the present heavy drop system, and future developments which will increase heavy drop capabilities will do much to increase mutual understanding.

Today's paratrooper is plagued by limitations in weight and size. Much of his aërial delivery equipment requires refinement. But the future is bright—improved heavy drop platforms, disconnects, restraint and release devices, cargo airplanes, assault airplanes, and helicopters are periodically making their appearance. As Colonel Cornett stated in the December 1945 issue of the *Military Review*:

"The future is open. The means are at our hands. We can move corps and armies with their weapons by air, and by air we can support them. All that remains is to determine to do so."

The New Look in Missiles

Army photo

A NUMBER of new missiles were recently revealed to the public as they approached operational status —Corporal, Honest John, Sparrow, and Viking have joined Nike in our arsenal of missiles. One can infer from the many years it has taken to perfect the publicized weapons that many "birds" exist in various stages of development to make up a complete weapons family in this category.

As there can be no all-purpose missile any more than an all-purpose gun, we can expect air-to-air, air-to-surface, surface-to-air, and surface-to-surface missiles of various ranges and effectiveness, many with nuclear warheads, to enhance our fighting capabilities. All sensible citizens will appreciate that information on missiles will always be meager to make countermeasures difficult.

THE most impressive missile for size is the Army's towering *Corporal,* in production by Firestone Tire & Rubber Company and Gilfillan Brothers, Inc., after many years of experimental work at the California Institute of Technology's Jet Propulsion Laboratory and the Army Ordnance White Sands Proving Ground.

Corporal appears to be considerably larger than Nike and carries an atomic or high-explosive warhead. The complete system consists of the missile and mobile launcher and guidance equipment that give the field commander considerable flexibility in placement.

A powerful rocket motor drives the missile along a ballistic trajectory at several times the speed of sound giving a range "far beyond . . . the 280-mm. gun or the Honest John rocket."

As the small end of the scale the Navy's Bureau of Aëronautics air-to-air guided missile system, *Sparrow I,* has been announced. It has been under development by Sperry Gyroscope Company since 1947 and is in production at the Sperry Farragut Corporation, a special Navy facility in Bristol, Tenn. Douglas Aircraft Company is handling the development and production of the airframe elements, and, as in all missile production, a host of subcontractors are making parts.

Few details are released, but the approximate size and the configuration are shown in the accompanying photograph of the missiles under the wing of a Navy night-fighter aircraft. The Sparrow is rocket-powered and fully maneuverable at supersonic speeds, and the over-all system permits accurate control when the missile is fired from high-speed jet aircraft.

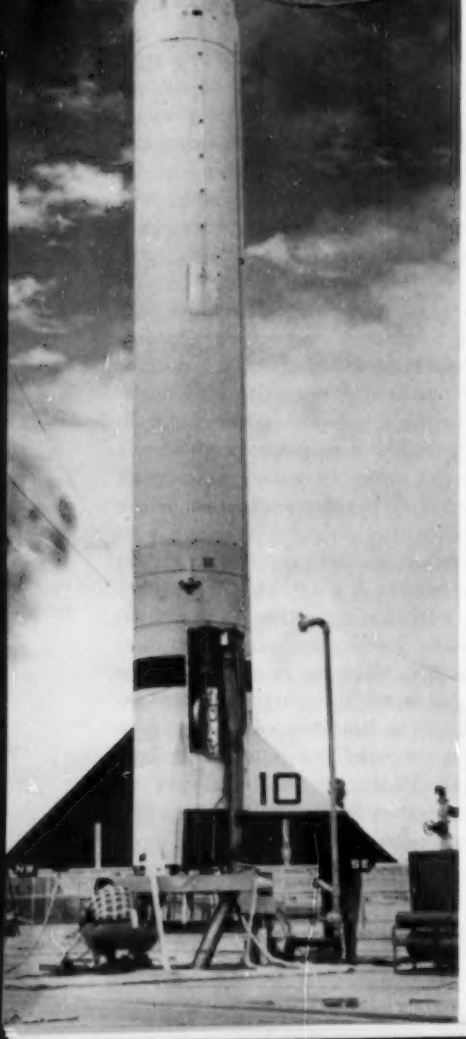
Honest John is an "unguided missile" or free-flight rocket for use as a front-line Army Ordnance weapon to complement medium or long-range artillery in tactical close support. It is capable of carrying either an atomic or high-explosive warhead.

Although the rocket weighs several tons, the self-propelled launching equipment is so light and fire control so simple that the system has greater battlefield mobility than conventional artillery. The high-capacity head can be loaded with standard explosives equivalent to the destructive effect of hundreds of artillery shells.

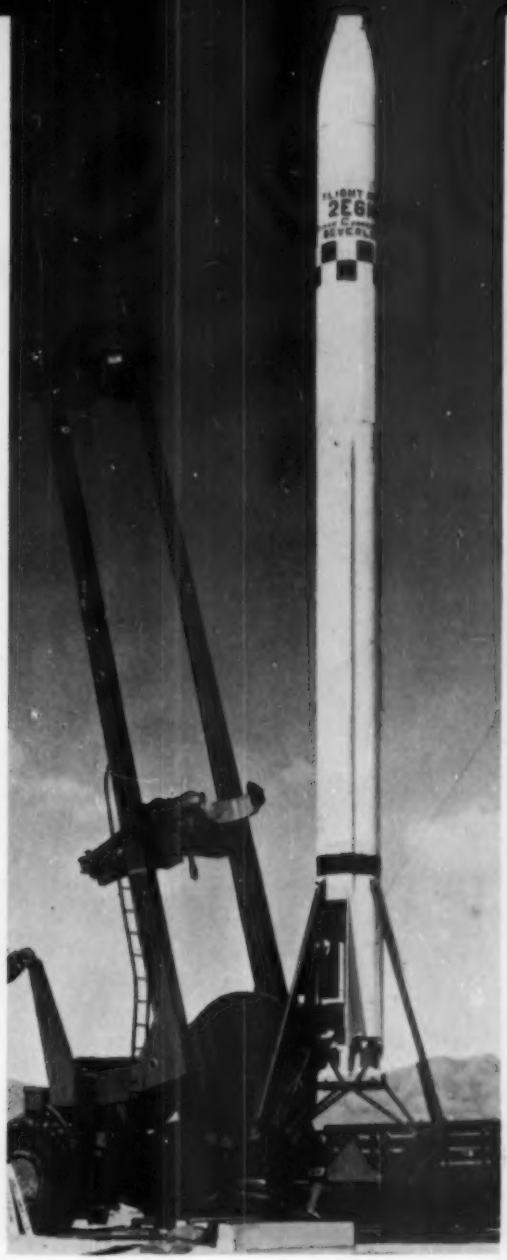
THE rocket assembly consists of warhead, rocket motor, and fin sections. It is so designed that the major parts are shipped assembled from the factory, and the warhead and fins attached in the field near the firing site to which it is moved rapidly on a self-propelled launcher. Honest John is aimed and fired like an artillery piece.

This rocket was conceived in May 1950 and put into full-scale production early in 1953. After testing at White Sands Proving Ground, Douglas Aircraft Corporation prepared the designs and is manufacturing this weapon under Army Ordnance specifications.

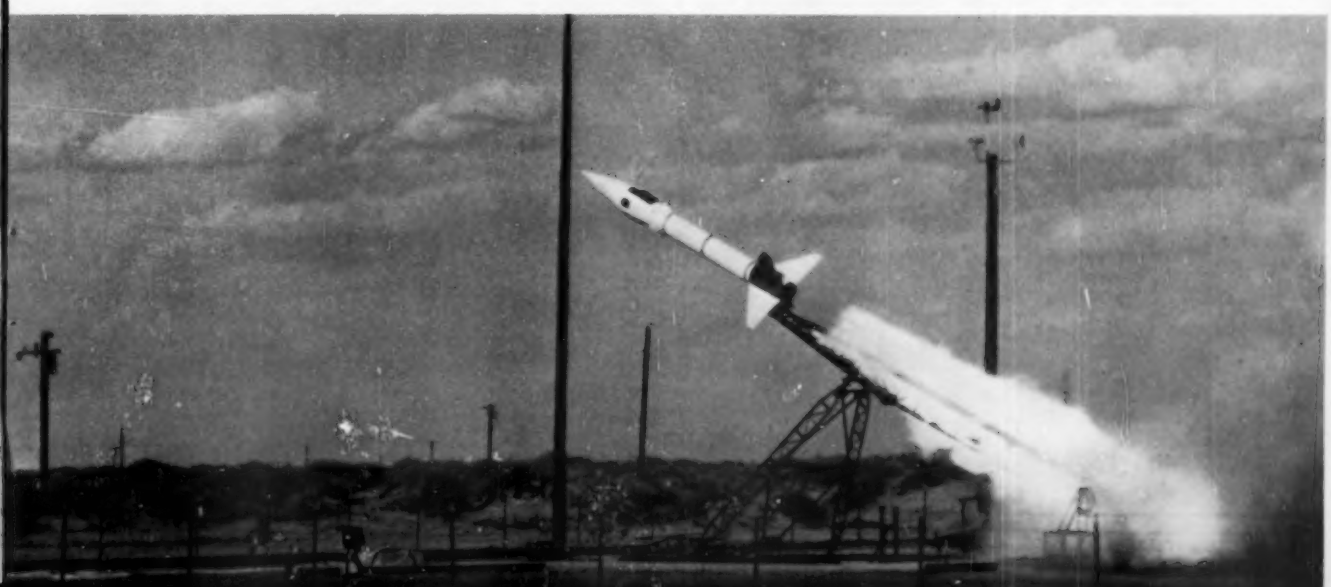
Viking is actually a research vehicle rather than a combat weapon, but its performance indicates the capabilities of missiles. It is a 7½-ton, 40-foot missile that has attained an altitude of 135 miles, traveling up to 4,000-plus miles an hour under the 20,000-pound thrust of a liquid alcohol-oxygen engine designed by Reo Motors, Inc. Glenn Martin developed and is producing fourteen Vikings for the Naval Research Laboratory for exploration of the upper atmosphere.



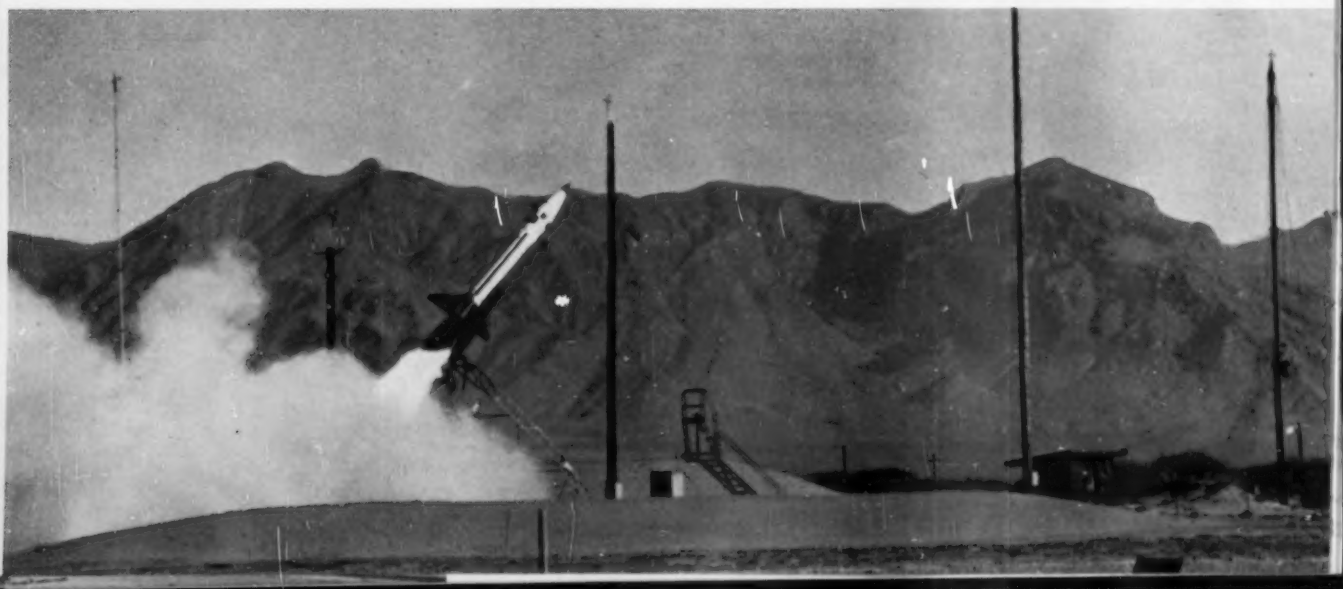
Above, the Army's surface-to-surface guided missile, the Corporal, is shown on its tactical transporter-erector at White Sands Proving Ground, N. Mex. (Army photo). Left, Viking rocket No. 10, designed and built for the Navy by the Glenn L. Martin Company, is prepared for launching at White Sands. This rocket is used primarily for high-altitude research. Below, Honest John, the Army's new free-flight artillery rocket is maneuvered into firing position on its special tactical transporter-launcher during recent White Sands tests (Army photo). It is aimed and fired like an artillery piece.



Above, the new Sperry Sparrow air-to-air guided missiles, hung on wing racks of the Navy's twin-jet night fighter, the F3D Skynight. Electronically guided toward their targets, the missiles travel at supersonic speeds when launched (Navy photo). Right, towering high above the ground, a Corporal stands in firing position while its tactical erector is returned to traveling position on the transporter (Army photo). Below, with a burst of flame, the Honest John takes off during a test flight of the new artillery rocket held at White Sands. It is designed for tactical close support (Army photo).



Above, crewmen inspect the Corporal from the mobile, cranelike servicer while the missile rests on its launcher preparatory to firing. Below, the Honest John takes off from a test launcher at White Sands Proving Ground (Army photos).



Steel Cartridge Cases

The Federal Cartridge Corporation has successfully utilized postwar knowledge to meet and solve problems of manufacturing caliber .45 steel ammunition cases at Twin Cities Arsenal

William N. King

DURING the early part of World War II it was apparent to the Ordnance Department that there was not sufficient copper for use in small-arms ammunition cases if the war was to be of long duration. Efforts were therefore made to substitute a low-carbon steel for brass in cartridge cases.

This work was pioneered by Frankford Arsenal and later much of the experimental work was assigned to other small-arms plants. The further development and the manufacture of the caliber .45 steel case was given to the Chrysler Corporation. Its Evansville, Ind., plant was set up to mass produce caliber .45 cartridges with steel cases.

This effort was very successful, and soon Chrysler was producing the bulk of the caliber .45 cartridges used in World War II with steel cases. After the war, the Evansville plant was dismantled, but some of the machinery and other equipment was retained by the Ordnance Corps of the Army.

AFTER World War II some caliber .45 steel-cased ammunition was made at Frankford; however, in the last part of 1952 Army Ordnance decided that other facilities should be set up for the manufacture of this ammunition.

Among these facilities was Twin Cities Arsenal, whose contractor-operator was Federal Cartridge Corporation. Again the reason for setting up a plant to make cases from steel was the possible shortage of brass if an all-out war should come about, as well as to develop, bring up to date, and maintain the know-how for the manufacture of steel cases.

Mr. King is technical director for Federal Cartridge Corporation at the Anoka Plant and Twin Cities Arsenal. He also serves as a member of the Ordnance Integration Committee and of the Steel Cartridge Case Committee of the American Ordnance Association.

Some of the production equipment was available from Ordnance Corps stocks; however, all the heat treating, plating, phosphating, and the balance of the production equipment had to be procured by Federal Cartridge Corporation. Due to the shortage of caliber .45 machinery, Federal Cartridge Corporation had to substitute other machinery, mainly caliber .30, and retool these machines so that a line could be established to manufacture the caliber .45 steel case.

Moreover, the machinery received from the Ordnance Corps had to be cleaned, repaired, have missing parts replaced, and be tooled and adjusted before it could be used. These were considerable tasks and required some time to carry out.

Enough of this equipment was available, except for plating, by May 1953 so that pilot-plant production could be started. The majority of the tools used to date by Twin Cities Arsenal have been tools left over from the Chrysler operation.

The method of manufacture of the caliber .45 steel case is similar to that used for making the brass case. The first step is to form the cup from strip steel—an operation performed on a double-action press which punches and forms five cups per stroke. Considerable difficulty was at first experienced in this operation which was traced to improper lubrication and to the fact that the steel strip had such a smooth finish that it would not hold the lubricant.

Die life was short, and considerable trouble was experienced with scratched cups. However, by the use of magnets and a settling tank to allow small chips of steel to settle out of the cupping solution and by the adoption of a lubricant which would wet and stick to the strip, much of the cupping difficulties were subsequently eliminated.

EVENTUALLY it was possible to use either steel dies or combination steel and carbide dies in this operation.

After the cups are formed from the strip steel they are washed with an alkaline solution to remove the lubricant used in the cupping process. The cups are then visually inspected to remove those with defects either from cupping, such as scratches, or those with defects arising out of the steel strip itself, such as scratches, surface laminations, inclusions, etc.

The next operation is one of the most important as far as a successful steel case is concerned; namely the annealing of the cups. At Twin Cities

Arsenal this is accomplished by passing the cups through a controlled-atmosphere, belt-type, electrically heated Lindberg or Sunbeam furnace. The temperatures used are 1,320 degrees Fahrenheit in the first zone and 1,400 degrees Fahrenheit in the second zone. The cups are heated in the furnace for thirty minutes.

The next operation that Federal Cartridge Corporation performs varies somewhat from that performed by Chrysler. During the Chrysler operations the cups and the components at the various draws were coated with a thin immersion-type copper coating as a drawing aid.

IN place of the copper coat as a drawing aid the Federal Cartridge Corporation uses a phosphate film plus a soap coat which has the following advantages over the copper film: (1) better protection from rusting of the components during storage between the operations, (2) better tool life, and (3) easier removal at the end of the operation. This phosphating is done by a Stevens automatic phosphating unit. The components are phosphated after each draw.

Next the phosphated cups are given the first draw. On the draw operations, carbide insert dies and highly polished steel punches are used. A dilute soap solution is pumped over the components to act as a coolant. The production rate on all the draws is exactly the same for steel cases as it is for brass.

After the first draw, the components are washed in an alkaline solution, phosphated, and then are ready for the second draw.

The second draw is similar to the first in that the same type of machine, as well as tooling, is used. These presses are the duplex type, and one operator handles one machine. Each machine produces about 400 components a minute.

After the second draw the components are washed to remove the drawing solution and then are given a normalizing heat treatment. This operation is done on a Lindberg electrically heated, belt-type, controlled-atmosphere furnace.

The temperatures used are 1,600 degrees Fahrenheit in the first zone and 1,725 degrees in the second zone. The components are in the furnace for thirty minutes. This furnace has a cooling chamber so that the components may be cooled below the discoloration point before they leave the nonscaling atmosphere.

Next the components are phosphated and then are ready for the final or third draw. As in the other draws, the components are automatically fed into a specially tooled Bliss No. 304 press which draws four components per stroke. Again a soap solution is used as a coolant. The drawing tools are similar to those mentioned previously.

The accompanying article describes the work performed with outstanding success at the Twin Cities Arsenal in a field of ordnance operations where skill, experience, and management in high degree are essential.

The steel cartridge case for small-arms ammunition, as shown in this article, has come of age, but not without the application of know-how based on the best of engineering techniques and facilities.

What Mr. King has written here describes a major contribution to American ordnance progress.

Federal Cartridge Corporation, under the presidency of Charles L. Horn, undertook the operation of Twin Cities Arsenal during the Second World War. Mr. Horn brought to the assignment his own long and successful experience as head of that company and applied it without stint or limit during that conflict and again during the Korean War.

Thus this article is a factual record of an achievement by an individual and an organization which indicates the important place both hold in the modern structure of our national defense. Both will be accorded a deep measure of appreciation.—THE EDITORS.

After washing the drawing solution from the components and drying them, they are ready for the first trim. In this operation a small automatic-type lathe trims off the excess material from the mouth, or open end, of the case. This operation trims all the cases to the same length and gives each case a square mouth.

From this operation the components go to the heading operation where the pocket for the primer is formed, the identification stamps are imbedded in the head of the case, and the inside of the case is given its final shape. This operation is carried out on a horizontal, toggle-type, double-action press.

In the Chrysler procedure, this operation was divided into two parts; the first, pocketing, which partially formed the head, and the second, heading, which completed the operation.

However, Federal Cartridge Corporation has found that these two operations can be combined and thus eliminate one operation and cut the number of machines necessary in half. This change has resulted in considerable cost savings in the manufacture of steel cases.

The formation of the extractor groove is the next operation. In this operation, which is done on a small, automatically fed, specially tooled lathe, the final external dimensions of the head of the case are completed.

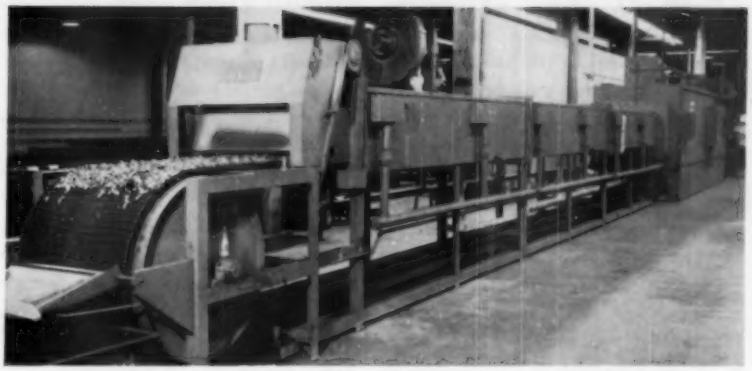
Some difficulty has been experienced in obtaining normal tool life on the cutting tools. However, this has been largely overcome by cooling the tool with a jet of air and by getting the proper relationship between spindle speed and rate of cut and by using a special steel for the form tool.

THE next operation is known as the final trim. Here a machine trims the mouth end of the case to hold the length of the cases to very close tolerances.

After the cases are trimmed, the primer pocket is vented so that the flame and hot gases from the primer upon firing can ignite the smokeless powder. With the brass case, this operation is combined with primer insert, but this cannot be done with the steel case as the punching of the vent hole would leave bare steel exposed.

This might cause rusting at this point, and it is conceivable under extreme conditions that this rusting might fill the vent hole and cause difficulty in ignition of the smokeless powder. It might also cause a hangfire or misfire, both of which are very serious defects, and every precaution must be taken during the manufacture of ammunition to prevent them.

One of the difficulties experienced by all who have manufactured caliber .45 steel cases has been the splitting of cases when the round is fired. This trouble has been particularly noticeable when the rounds are fired in the M3 submachine gun.



Lindberg controlled-atmosphere heat-treating furnace used at Twin Cities Arsenal.

THE nature of this gun requires that it have a comparatively large diameter chamber which does not fully support the cartridge case. Therefore, the cartridge case must expand considerably when fired.

These splits, when they occur near the head of the case, are particularly objectionable. To eliminate this highly objectionable defect, Federal Cartridge Corporation has found that a stress-relief anneal on the finished case is necessary.

This operation is carried out by passing the cases through a Sunbeam electrically heated, atmosphere-controlled, belt-type furnace. The temperature used is 1,250 degrees Fahrenheit, and the total time in the furnace is only 6 minutes.

This short time exposure is adequate to remove any stress which may have developed in the material during its final operations and also results in a very tough and ductile case. It does not interfere with the extraction of the fired case.

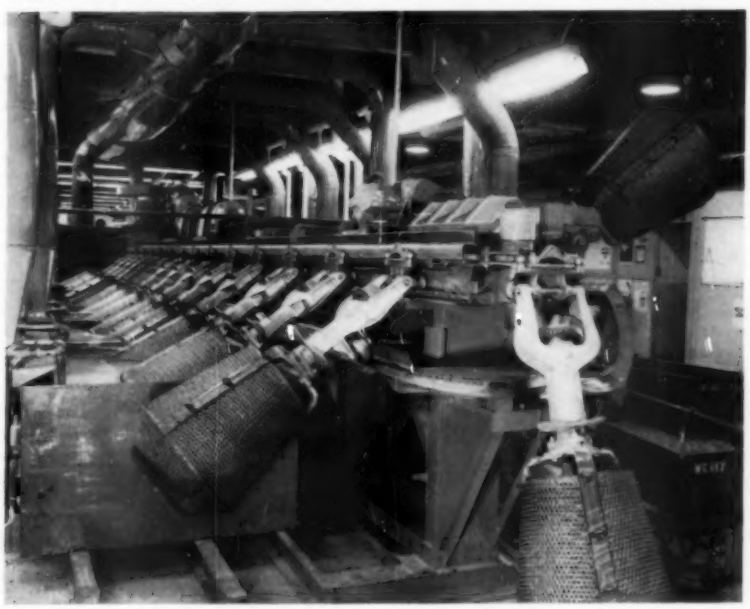
The final operation on the steel case is the plating. Steel cases, unlike brass, need some type of coating to prevent rusting. The standard protective finish for most small-arms ammunition is zinc, electrically plated on the case, followed by a supplementary chromate treatment to give added rust resistance.

Small cases, such as the caliber .45, are most conveniently plated in automatic plating units. These large units automatically clean and barrel-plate the cases. After plating, the cases are fed into a second machine which puts the chromate finish on the cases and rinses and dries them.

This briefly summarizes the process of manufacture of the steel caliber .45 case. The manufacture of the bullet, the priming of the steel cases, the loading with smokeless powder, the gaging, and the final visual inspection are the same as for the conventional brass cases, using conventional machines.

It should be mentioned here that throughout the manufacture of the steel caliber .45 case a very important rôle is played by the process inspection department. At each step in the manufacture of the case, process inspectors carefully gage numerous components to insure that they meet the tolerances set up for that particular operation.

Stevens automatic phosphating unit used in making caliber .45 steel components.



DIAL-TYPE gages that measure as accurately as two-tenths of a thousandth of an inch, plug gages, snap gages, in short, all the various types of gages normally used in holding metal components to close tolerances are employed.

The information gained by the process inspectors is carefully plotted on quality-control charts which give at a glance the quality of components being produced at any one time by any one machine. This information is very useful to the production and inspection divisions, as it permits production of uniform components on a mass-production basis.

Periodically, samples of cases are taken after venting and are primed, loaded, and fired in the prescribed test weapons to see that the case quality is such that it will not cause excess firing defects. A similar test is made on each lot of cases after they return from the plating operation.

It might be mentioned that to date all the plating has been done by a local commercial plater; however, eventually it is expected that Federal Cartridge Corporation will have the equipment to do its own plating and to do the chromate dip.

Finally, after a lot of cases is loaded, gaged, and given a final visual inspection, a third sample of ammunition is tested to be sure that the quality is up to standard. After this test, if the ammunition satisfies the contractor as far as the quality is concerned, the lot is submitted to the Ordnance Corps for evaluation, final grading, and acceptance.

After the ammunition is accepted, it is packed according to the type of packing ordered by the Ordnance Corps under its supervision.

PROBABLY the most serious difficulty in producing steel cases is that of obtaining uniform steel. This difficulty is usually manifest in metallurgical properties, such as laminations, improper anneal, inclusions, scratches, etc., but also sometimes involves excess variations in thickness or in lack of uniformity of thickness of the strip. Defective ammunition from the above causes is very difficult to remove by visual examination.

Another difficulty experienced in setting up to run steel-cased caliber .45 cartridges was the determination of the proper temperatures and the proper time intervals for the heat treatments.

While the data on these operations were available from the Chrysler procedures, different furnaces were used from those at Twin Cities Arsenal, and, consequently, the equivalent temperatures and time intervals in the furnace had to be determined experimentally. This required considerable work, and many sample lots of ammunition had to be made up and test-fired in order to determine when the proper annealing temperatures and time intervals had been reached.

In addition, along with all these test runs, samples were given a complete metallurgical examination which also was quite a time-consuming task. In spite of all these difficulties, scheduled production of the caliber .45 steel-cased ammunition was started in September 1953, and in each succeeding month the production schedule has been met.

The quality of the ammunition has steadily improved from twenty per cent Grade A in October 1953 to ninety per cent in December 1953. Actually Federal Cartridge Corporation is now four months ahead of its promised first scheduled month of caliber .45 steel-cased ammunition production at Twin Cities Arsenal.

Of significance also is the fact that since World War II the percentage of split cases permitted has been reduced about one-third; consequently, the quality level of the ammunition had to be increased to meet these new specifications. This improvement in quality was largely obtained by getting the proper heat treatments at the various stages, plus careful inspection at all stages of manufacture.

Based on the Chrysler experience of World War II and the present experience of Twin Cities Arsenal, there is little doubt that caliber .45 steel cases can be produced in any volume required by the Ordnance Corps, provided sufficient time is given an arsenal to secure the necessary equipment and provided an adequate supply of uniform steel is made available.

THE present Twin Cities Arsenal equipment is set up in such a manner that either brass or steel components may be processed. It is interesting to note that it is possible to produce satisfactory brass components with practically the same tooling as for steel.

At present it appears that when our caliber .45 steel equipment is completely set up, and if substantial quantities of caliber .45 steel ammunition are produced, the cost of steel-cased ammunition will be no higher than that of brass cases.

In conclusion, it is felt that Federal Cartridge Corporation at Twin Cities Arsenal has brought the Chrysler Corporation World War II method for the manufacture of caliber .45 steel cases up to date by taking advantage of the newer drawing aids developed since World War II and by improving the technique and know-how of manufacturing caliber .45 steel cases so that the higher quality levels of the Ordnance Corps specification can be met.

Eight successive steps in the manufacture of caliber .45 steel cartridge cases are shown left to right: cup, first, second, and third draws, first trim, head turn, final turn, and at far right, the final product loaded and ready for delivery.

Watertown Remembered

Training under General Tracy Dickson at the old Ordnance School was tough, demanding, and invaluable in creating the high caliber of officers for which the Corps is famous

Brig. Gen. Thomas K. Vincent

"ALL officers of the Ordnance Department, whether detailed or assigned, will take the prescribed 2-year course at the Ordnance School." So stated a 1920 policy of the Ordnance Department, United States Army.

In the 1920's, Regular Army officers were urged by a casual War Department circular to apply for a 4-year detail in the Ordnance Department. If successful in obtaining such a detail, the fortunate officer would receive two years of schooling, one year of graduate work at the Massachusetts Institute of Technology, followed by one year of industrial training at the Watertown Arsenal.

VISION of an extension of West Point or college training at Government expense was unbelievable. The thought of two years of study on a leisurely basis, with extracurricular activities, elective courses, no military formations, and a college atmosphere, leading to the award of a higher degree, was irresistible. Those of us who were interested and had the qualifications applied by the dozens. We were accepted singly and selectively.

Months later, the letter of notification of selection came from the Personnel Officer, Office of the Chief of Ordnance, in Washington. It gave out with the long-awaited information and assignment: Watertown Arsenal, Watertown, Mass., duty with the Ordnance School as a student, reporting 1 July. This was followed, rather as an anticlimax, by the formal War Department orders confirming the detail for four years in the Ordnance Department and directing travel to Watertown Arsenal on permanent change of station.

Brig. Gen. Thomas K. Vincent is an outstanding Army officer who is now in command of the Army Ordnance Rocket Center, Redstone Arsenal, Huntsville, Ala. In this article he writes with feeling and understanding about another Ordnance officer of an earlier generation—General Tracy Dickson, whose name and fame are legendary among the Ordnance fraternity.

Having studied under General Dickson, the author, like many of his contemporaries, has put to finest use the Dicksonian principles and policies throughout the subsequent decades. These principles and the men who have lived by them have helped to make the Ordnance Corps the outstanding military organization it is today.

Shortly thereafter, our introduction to Watertown Arsenal began with an official letter. It was a pithy letter, and it contained not one word of welcome, nor of information, nor was it full of compelling adjectives nor lurid promises to confirm us in our decision to seek service and further education in the Ordnance Department. It was snappy, short, curt, serious, dry, and almost forbidding. It contained a concise and somewhat unfamiliar list of subjects to be covered at the Ordnance School. The first twelve months would be spent at M.I.T., the second twelve at the Watertown Arsenal.

Questions arose in our minds at once: No summer vacation? Classes in the summer time? What about leave?

The facilities of the Watertown Arsenal library were offered as a source for obtaining textbooks in advance with which to refresh our minds. Any questions? Communicate directly with the Commandant, The Ordnance School. This letter was signed: "T. C. Dickson, Colonel, Ordnance Department, Commandant."

T. C. DICKSON—a name which had been indelibly fixed in the minds and memories of hundreds of Ordnance officers in the past—was to be equally fixed in ours. To those of us who were detailed from the line, T. C. Dickson was just another name—a colonel—no different from those colonels with whom we had come in contact in our line branches.

To those of us who were already serving with the Ordnance Department, the name T. C. Dickson conjured up fearful legends as fantastic as those surrounding Paul Bunyan or Ghengis Khan. Older officers told frightening stories of this man. He was alleged to be most unreasonable, profane, explosive, and demonstrative and to expend junior officers with reckless abandon.

Almost without exception, no one took the letter from the commandant

too seriously. To us it was just another routine letter. To forget it seemed in order. Our experience in the Army was short, and we were contemptuous of any document which required too much effort to figure out. Besides, this was only March, and July was a long way off. Did we live to regret this? We did —to a man.

WE drifted into Watertown Arsenal after leave or travel during the last days of June. The brick headquarters building at the arsenal, with its clock tower and ivy-covered walls, looked the part of a cloistered abbey.

Within its darkened halls we had some difficulty in locating that important minion—the adjutant. In any headquarters we had seen up to that time the adjutant was always in a conspicuous location near the front entrance. Here the adjutant's office was on the second floor, away back in a little-used wing. The adjutant was polite, but he was in a hurry to get away. He had other duties, and in this added duty of adjutant he merely signed the morning report.

We asked questions. Quarters? No quarters. Furniture on memo receipt? None. List of places to rent? Sorry, no list. What about signing in? There was a sign-in book somewhere. Better ask the sergeant. The sergeant untangled himself from the cobwebs, eventually found the book, and we signed in.

We were now officially on duty with the Ordnance Department and the Watertown Arsenal. It was different and pleasant somehow. No military formations, no military procedure, no uniforms, and a break with tradition when it was found onerous. This, then, was the Ordnance Department.

Watertown Arsenal was an industrial installation, in which military protocol was unrecognized, except for that small increment pertaining to rank and seniority, which could not be set aside.

On the first floor, directly under the adjutant's office, was an office on which the sign read "Assistant Commandant, The Ordnance School." We almost missed it as the wing in which it was located was unused except for this purpose. The assistant commandant was friendly and helpful. He answered our few questions. Should we call on the Old Man at his office? No—very definitely no. He would send for us if he wanted to see us.

Brig. Gen. Tracy Campbell Dickson about 1922.

Should we call on him socially at his quarters? Well, if we chose to, all right, but he advised against it. General Dickson lived alone in the big house except for his servants. He would hold his customary reception later on for all the students. That would take care of all the social calls.

WHAT about this "General" stuff? Oh, the General was a colonel now, but he had been a brigadier general for a time. It had to do with the building of the Panama Canal, the locks or the machine shops or something. Possibly it had to do with World War I —anyhow he had been a General and was always addressed by that title. We never forgot that.

What were our duties? Get settled and report to the General's office at 8:00 a.m. on July 5th. Get settled—where? Go find a place. Did the arsenal have a list of available places or suggestions as to a likely neighborhood? Unfortunately, no. The students in the past had always managed somehow. Where were the commissary and the post exchange? None available—and an odd look which questioned why we should expect such things.

So much for our preliminary indoctrination. We were pretty much on our own until July 5th in a strange place. By devious means we got settled and awaited D-day (Dickson day).

I am sure that had it been possible for us to return to our line branches without stigma, many would have done so gladly. We were acutely aware that Ordnance was different. However, after the novelty wore off and we contemplated it, it did not look bad at all.

D-day, July 5th. We arrived singly from 7:30 a.m. on, converging on the Headquarters Building at the arsenal. We formed little groups, discussing living conditions, rents, transportation, and the Ordnance life before us. One of our number appeared in uniform, the rest of us were in civilian clothes. We had received no instructions as to the clothes to be worn.

All of us were nervous, being junior officers, and unused to colonels and generals (busted or not) for any length of time. And the build-up General Dickson had been given only added to our excitement.

At 7:58 a. m. the assistant commandant emerged from his lair. "The General is ready. Go to his office and

sit down," he announced. We filed singly down the dark hall, through an open door at the end into the General's office. Obeying instructions, we entered silently and sat in the double row of straight-back chairs arranged in a precise formation in front of a large flat-top desk.

This desk was in the center of a very large room. Absolute silence filled the room. I recalled Robert W. Service describing the frozen North as "plumb full of hush." The similie was apt.

WE had time to survey our surroundings quietly. Many portraits of bearded officers in uniforms of another day peered down at us from the walls. A young lady, obviously the General's secretary, sat at a cluttered desk, directly in rear of the aforementioned flat-top desk. She was quietly dressed and quieter in manner, very much in keeping with the rest of the room. I was reminded of a wake.

The survey of the room was soon over and we could concentrate on the desk. It was of ancient vintage, made of solid oak, fully six feet wide and four feet across and seemed to be several inches higher than an ordinary desk. A small shelf, sloping toward us at an angle, protruded from the front side of the desk.

The desk was cluttered with bulging desk baskets, an old-fashioned inkwell, several wooden penholders with their steel pen points, two telephones, many files of correspondence, books, papers, an ash tray, and across one end of the desk lay a cane, surmounted with a curved handle tipped with ivory. It showed much use and was badly scarred. It was well worn where it had been gripped time and again by a firm hand. Back of the desk was a very high-backed office chair, with a cane seat and back which enveloped the one who occupied it.

In this chair sat a man—the General. He was tall, even when sitting down. He had graying hair, neatly combed, thinning a bit on the top. He was dressed in a gray suit and wore a white shirt with a stand-up collar. His necktie was white, tied four-in-hand, made of some sort of washable material.

We observed the top of his head, his shoulders, and his hands for some time as he attentively read the papers on the desk before him. He had not looked up when we entered, nor had he looked up since we had seated ourselves. He appeared to be unaware of our presence.

Several times without looking up he reached out a tanned, veined hand and plucked a single cigarette from an opened pack on his desk. As if by magic a box of matches appeared in his other hand. He tapped the cigarette three times on the matchbox, then put it to his lips and took several dry drags on it, as if to turn it wrong side out.

Apparently satisfied that an air passage was assured through the cigarette, he then pushed the tiny drawer of the match box about halfway out. He deliberated, pushed it back in place and on through the other side until it protruded about half way. Then and then only did he reach in the matchbox and remove a match. He closed the box firmly, pressing on both ends as if to weld the parts of the box into a solid mass.

All of this was done without looking up from the papers on his desk. He had our undivided attention. When we had about decided that he had given up all idea of smoking, he surprised us with a lightning movement, striking the box forcibly with the match, so that it burst into flame with an explosive effect.

Quickly and efficiently, evidently from long practice, he completed the business of lighting the cigarette, then sucked great drafts of air through it loudly and forcibly. A fourth of the cigarette disappeared under this violent treatment in the flick of an eyelash. He inhaled, paused, stuck out his under lip, allowed the smoke to curl up over his upper lip and disappear up his nose.

The smoke did not reappear or, under the hypnosis of the occasion, we were unaware of what followed. Each drag on the cigarette produced smoke that made a round trip and a half and that was all. The General was a real smoke-eater—or possibly a fire-eater!

His routine never varied. Six drags and the cigarette was consumed for all practical purposes. He was a chain smoker, although he never lit a fresh cigarette on the burning remains of an old one. The ritual of the match and the lighting of the cigarette was too firmly fixed as a part of this man—the General.

Not one of us dared light a cigarette. We were not sure of ourselves in the presence of this man we did not know. Our indoctrination, by legend and gossip, as to his improbabilities frightened us. We spent about thirty minutes in silent contemplation of this man, about whom we had heard so much—much that was to be feared—and from whom we were expected to learn the fundamentals of ordnance.

We were lulled into a state of semi-consciousness when, with a start, we realized that the General had finished his work or had put it aside to perform what appeared to him to be a disagreeable task. He was looking us over one by one. "Looking us over" hardly expresses it. We were being looked at, looked through, turned wrong side out and examined, all with quick contemplation. And thus, we saw the General, for the first time, face to face.

I COULD think only of Lon Chaney, the late great character actor as the first sergeant in "Tell It to the Marines." At that, the General out-Chaneyed the original. He had a strong, lined face, with piercing eyes, almost as piercing as those of General Crozier, a famous Chief of Ordnance who will always hold the world's record in Ordnance for that accomplishment. He had thin lips, a strong, slightly protruding jaw, and fierce determination written all over his face.

As he passed from one to another, he seemed to assess our probable worth and appeared to utter contemptous snorts and snarls. This was not so, just our overworked imaginations. The scrutiny increased in intensity and deliberation as he passed to the rear row of seats. Apparently he was not pleased with what he saw. Not one of us felt that he had a chance of making the General's team.

We settled lower in our chairs, looked back pleasantly and seriously, with that wooden stance that is an accomplish-

ment of plebes and junior officers. We hoped for that one glint of human understanding, one sympathetic gesture, one ray of hope, but we were disappointed. Thus we met the man who was to be our commanding officer for the next two years—that is, if we were not returned to our stations in the meantime.

HE was Brig. Gen. Tracy Campbell Dickson, Ordnance Department, United States Army, cobuilder of the Panama Canal with that great engineer, General Goethals. He was a "black-leg," a title that distinguished certain Regular Ordnance officers from the rest. Those Ordnance officers who were in the Ordnance Department when the old-style blue uniforms were in vogue, got that title from the color of their dress trousers.

These trousers were black without a stripe, or with a black stripe, whereas the other officers wore sky-blue trousers with a colorful stripe denoting their branch.

General Dickson was the toughest, fiercest officer we were ever to meet but a man possessed of a brilliant technical mind, ranking easily with Rodman, Buffington, Crozier, and others of equal fame. He was a far-seeing and progressive man, with a thorough understanding of industrial management and engineering practices and procedures.

In all he was an outstanding Ordnance officer, who used the unusual and spectacular approach to fix firmly the points he wished to make. As first-year students we never learned of his human side. To us he was always the unswerving, strict disciplinarian.

I served with him for four years following my tour with the Ordnance School as a student, and I found him to be one of the kindest, most thoughtful and understanding men I have ever known.

His personal survey completed, he got down to the business at hand. He turned to the lone member of the class who had appeared in uniform. He said:

"I do not like uniforms. This is an arsenal, an industrial plant. You are going to attend a civilian school. Do not wear the uniform, while you are here, unless I order it. Besides making a man look like a monkey, they are unhealthy, uncomfortable, ill-appearing, and just what you would expect in the way of an outfit designed by the Quartermaster Corps. No man can do his best work with his neck choked by a tight collar and that harness we got from the British—Bah!!"

We were sympathetic for our comrade who had unknowingly violated the code of Watertown Arsenal. The General continued:

"Each year or so, some selfish, brainless moron comes to the Ordnance School and dies here, without leaving a will. I have to take care of his affairs, which are always in a mess, and his widow and his children are at the mercy of the courts. The scoundrel is usually in debt, and there is hell to pay. If you have not made a will, make one before the sun sets on this day. Make any kind of a will, but make one. See a lawyer, if you want to. Ask Mr. Carney, the chief clerk—he's a jack-leg lawyer. I can't express my contempt for the low-lived skunk who dies and leaves a family to struggle with the laws and regulations that take over where there is no will."

There was more to it than this, various and choice expletives and profane allusions. He really warmed up to this subject, probably due to a recent experience. He picked up the cane lying across the desk and brandished it and parried with it. He ended by sweeping all the papers and other impedimenta from the top of his desk with it. His secretary, apparently accustomed to this, calmly restored all to the desk again.

We would always, thereafter, remember about wills and their making. Unwittingly we were getting into the mood expressed by this man—the General. This business of wills made sense to us.

Next, he took up the question of budgets, and placed a curse on the house of the conceited pup who believed he could live on his Army pay without having a budget. This, too, he illustrated with choice examples and phrases. He named names and places. We were admonished immediately to start our finances on a system of budgetary control. This, too, made sense. We were beginning to feel bruised and shaken by his rigorous presentation, but we were getting our second wind.

He covered the field of education from West Point, from which he graduated in 1892, to the present national system in our colleges. It was a national disgrace in his opinion, excepting only M.I.T. He observed the alleged stupidity emanating from Washington. In detail he related the story of Brig. Gen. Daniel Webster Flagler, Chief of Ordnance, during the Spanish-American War. He said:

"That general pleaded with the Congress, year after year, for money to make a little smokeless powder for rifle ammunition, only to have it denied him, time after time. And the Spanish massacred our troops in Cuba, because the black-powder cartridges our troops were forced to use gave our positions away. And the Spanish with their smokeless-powder cartridges picked our men off at will. Our men never had a chance. After the war the Congress investigated General Flagler and reprimanded him for failing to provide smokeless powder for our troops. The Congress was to blame themselves and would not accept it. General Flagler died within a few months of a broken heart, and the Congress crucified him as surely as if they had nailed him to a cross."

THAT was dramatic and impressive. Never before had we heard an officer speak out so positively and unafraid, but this was factual without doubt. Another lesson, perhaps, but the point and the antidote were not so clear at the moment.

He touched briefly on the Supreme Court and named a former president who had destroyed it's integrity, in his opinion, by his dominance. We were not too well versed on political and judicial matters occurring at the turn of the century. However, by this time we did not scoff nor doubt. We were receiving lessons in history and its interpretation right from the top. He

spoke with such conviction that we, too, seemed to be living these events ourselves.

He then praised the Manufacturing Service, now the Industrial Division, of the Ordnance Department. He treated lightly and somewhat contemptously the newly formed Field Service. It would not last, he predicted. It was some misguided person's idea; it was not needed and was a waste of manpower. This was internecine warfare with a vengeance and was strange to us.

He threatened one and all of us who failed a single course at the Ordnance School, or whose scholastic standing was lower than he thought acceptable, to a lifetime of duty with the Field Service. Consignment to Devil's Island could not have conveyed a mental concept of greater punishment.

That firm stand against the Field Service converted many of us who had experienced Ordnance supply from the user's point of view into devil's advocates—defenders of the Field Service.

HE then singled out the two junior members of the class, who had recently graduated from the United States Military Academy. In answering their introductory letters from the General, they had been rash enough to state that, in view of their recent graduation, they did not feel the need for further preparatory study. The offer of suggested texts from the library was very thoughtful but not required.

In explaining how wrong they were, the General rose to magnificent heights. He denounced their attitude of sufficency. He declared that he would personally watch their progress in the Ordnance School. He predicted that utter failure was in store for them if they were not, in fact, supermen, which he very much doubted. Eight of us were thankful that we were not of the two to whom he alluded.

West Point was his next subject. He covered his birth in Iowa and his boyhood on a ranch in Texas. He was appointed to the Military Academy in 1888, and in retrospect covered the deficiencies in the curriculum of that day and the modern idea of a military education. The engineering schools of the country came in for critical analysis too. He ended with a mild tribute to M.I.T. as being better than the rest. By now we wondered whether or not the General was putting on an act or was relating factual matters.

The telephone rang and the secretary interrupted the General. It was the Chief of Ordnance in Washington calling General Dickson. We were sure that the General would refuse the call, because the Chief of Ordnance was certainly not in the same league with the General. He took the call, however, and exchanged pleasantries in an ordinary tone of voice.

"In all, General Dickson was an outstanding Ordnance officer who used the unusual and spectacular approach to fix firmly the points he wished to make."

From the side of the conversation which we heard it was evident that the Chief was calling about some industrial matter affecting the arsenal. It was also apparent that the General was not happy about it. His voice rose and his arguments became more positive. Mentally we constructed the situation in Washington—the Chief of Ordnance pleading a lost cause with a commander in the field—and meeting his Waterloo.

The conversation ended quickly, pleasantries again, and the General turned again to us. He paid the Chief of Ordnance the highest compliment—an understanding man, but stubborn. We were admonished to always stand up for what we believed. There was no place in Ordnance for a "yes man." The Chief expected every Ordnance officer to answer honestly regardless of rank or position.

He alluded to the recent conversation with the Chief, expressed the wish that the Chief had decided in his favor. He shook his head. Loyalty may have been strained, but it was maintained nevertheless. We felt that if the Chief had met the General person to person he would have sided with him.

We were rapidly coming under the spell of this man—the General—whom we had met for the first time barely an hour before.

He asked if any one had a question. The senior member of our class had detailed in the Ordnance Department from the Field Artillery. He owned his own horse, as was customary among mounted officers in those days. He asked if he could stable his private mount at the arsenal. This was a proper question and a privilege normally granted.

The General well-nigh exploded. The rapidly approaching mechanization of the army and the death knell of the horse, except for rich wastrels, came in for its day in court. Our fellow student brought the argument back to the original question. After covering the horse in military service from the Crusades to World War I, the General granted permission.

There were no further questions. The General turned as if to engage himself with his papers.

The entire discussion took about an hour and a half. The General consumed about two packs of cigarettes. He had talked continuously, emphasizing his remarks with meaningful gestures with his hands, arms, and the ever-present cane. He remained cool and unruffled, apparently, through it all. There was no doubt as to his convictions and the firm stand that he took on all questions.

With a suddenness that startled us all, the conference was over. We were dismissed with a word and without military salute or order. We were not charged to "live and die for dear old Rutgers." We had received our baptism and initiation into the field of Ordnance education in the Army. It portended a tough and bloody two years.

The assistant commandant explained to us that class work was awaiting us at the Massachusetts Institute of Technology in Cambridge. We were to repair to that place without delay. He would meet us there. At 10:00 a.m. on July 5th we took off for the Institute.

We found the Ordnance classroom without too much difficulty, on the fourth floor of the Mechanical Engineering Building on the Massachusetts Avenue side of the campus. After we had assembled, the assistant com-

mandant introduced Professor "Eddie" Miller, colonel, Ordnance Reserve, head of the mechanical engineering course and dean of Army officers. After the recent ordeal at the arsenal we were still shaken, uncertain, and thoughtful. From the regimental routine of the line branches of the Army to this unusual and different treatment was just too abrupt. We were confused to say the least.

HOWEVER, Professor Miller, or "Eddie" as we always referred to him, was wonderful to us. He bade us welcome and hoped that our stay at the Institute would be pleasant. He told us that he would teach us advanced thermodynamics later in the school year.

He took time out to relate one of his many interesting experiences in the engineering world—his forty-seventh boiler explosion. He was dramatic—the situation was acute and he had been called in and arrived in the nick of time to prevent a holocaust.

Before the school year ended we had heard from him many other hair-raising tales connected with boiler explosions. None were repetitious, and all were exciting. We enjoyed them, and we loved and respected Eddie Miller as a gentleman, a fine instructor, and a friend.

During all this a bushy-haired man, quietly smoking a pipe, was standing in one corner of the room. He came forward when Eddie finished and introduced himself as Professor Phillips, who would teach us differential equations for the next six weeks at the rate of 8 hours a day, 5½ days a week. Also there would be several hours of homework each night. This was a steady diet of learning with a vengeance.

Such concentration was new to us. The General, we found later, contracted for so much teaching from M.I.T. He based it on the same production-schedule methods he used at the arsenal. His formula was: Man-hours of teaching, poured into a definite number of students, equaled a definite quantity of knowledge.

This also insured a full schedule for each student, since each student took all subjects. No study periods, no loafing, no monkey-business, and, in his own words, "M.I.T. was not permitted to confer any damn degrees upon us." We were disappointed at that, but wasted no time on the subject.

Professor Phillips started us off with a review of differential calculus which took a day and a half. We then launched into an equally rapid review of integral calculus, which was disposed of by the next afternoon. We were rusty and unused to study in concentrated doses, and the two recent graduates from the Military Academy were no exception. One student was heard to remark, "There goes six weeks of summer school at the University of Texas."

Professor Phillips opened the subject of differential equations by remarking that he taught somewhat different methods from other instructors. Often students attempted to use the older methods, but invariably they failed the course.

Was this a new deal? Were we faced with a mathematical inquisition? Nothing of the kind. It was a favorite remark of his, emphasizing that he was not a fogy and that we could expect advanced training. This was true as he made the subject so clear and interesting that we were sold on his methods of teaching from the start. Many of us had a liking for higher mathematics and found it more fascinating than ever under the tutelage of this excellent mentor.

"He was a leader of men, unorthodox in his methods, fair in his dealings, and unswerving in following the path dictated by his conscience and his thinking."

One hot summer afternoon a few weeks later we were aroused from our lethargy by the sudden appearance of General Dickson standing in the doorway of the classroom. He was carrying his cane in his right hand and held a cap in his left. This cap was the type worn by race-track devotees around the turn of the century, and was strange in this day of hats.

He nodded to Professor Phillips, who, having been through this formation in the past, retired to a neutral corner and lit his ever-extinguished pipe. He appeared to enjoy the intrusion as a welcome rest period for him.

Our class room at M.I.T. was equipped with regular office desks and chairs. These were arranged four in each row across the room and four rows in depth. We were not assigned desks in order of rank, each student permanently occupying the desk that he had selected on the first morning of school.

The General planted himself in front of the far desk in the front row. We all watched him wondering whether to keep on working, snap to attention, or to sit with arms folded after the manner or children in the primary grades.

The general interrogated the first student, asked his name, what he was doing, how he was getting along, and if he had any comments. Hearing none, he appeared to want to get an argument started, but neither this student nor any of the others rose to the bait when it was offered.

He moved on around the room, querying each of us in much the same manner. One of our number in his excitement, tipped his office chair over and landed under his desk. The General uttered some unintelligible sounds, but he was used to upsetting the equilibrium of young officers so he accepted this as a tribute to his continuing prowess.

The visit of the General took about half an hour. He picked up his cap, bowed to Professor Phillips, and departed. That was his first and only visit to our class while we were at M.I.T. We agreed that he had probably formed a definite opinion of each of us in that brief encounter.

THE General's smile merits description. His face was strong, lined, and severe. His expression was always stern —the face of a soldier, a leader, a man accustomed to being obeyed. When he chose to smile, it was a sudden action, passing instantaneously from severity to a complete smile.

I have heard it described at different times as a leer, smirk, grin, laugh, and grimace. I have never heard it called a smile, but that was what it really was.

He could turn it off just as suddenly and quickly. Invariably one found himself smiling back at the General only to find that he was no longer smiling but was looking fiercely at you, straight in the eye. This unbalanced many a young officer. To the General, I'm sure it was a game that he thoroughly enjoyed.

We completed differential equations one hot afternoon and the next morning started another subject on the same rigorous schedule. This course passed quickly and we found ourselves in September with a whole week in which the Institute had no scheduled classes.

We held a caucus to decide what we would do with the week of freedom. We ended by selecting one of our number to query the assistant commandant as to whether we were free during this period or not. We were officers and our time had to be accounted for.

The assistant commandant knew the answer. The General had nothing for us to do. Since we were students at M.I.T., we could do as we pleased when classes were not held. But, we were warned, if we left the environs of Watertown, we should take leave.

In explanation, the Inspector General might pop in and ask for us, and if we were not here or on leave it would be a serious matter. In fact, we would be AWOL, subject to the Articles of War, a court-martial, dismissal from the Army, or some lesser punishment.

Those of us who had plenty of leave took leave of absence. The rest of us took a chance.

After this week of surcease from our labors we entered the regular fall semester at the Institute. We soon fell into the routine followed by any other graduate student, with this difference: the schedule continued to be prepared by General Dickson, with every hour accounted for. We had no electives and no free time.

Our schedule was 8 a.m. to 5 p.m. every day except Saturday, and on that day we had a few odd hours in the morning.

The course required at least four hours of study each evening with extra study on Sunday. We survived it, however, and the year, except for a short Christmas vacation and a few days between semesters in the spring, was spent in concentrated application to our studies. Then June arrived and we were through at M.I.T.

On July first, after a few weeks leave, we again reported to the arsenal to start the second year's course there. This was an industrial course, and we found through liaison with the class ahead of us that we would punch time clocks, absorb the workman's viewpoint, prepare endless notebooks, but that there was little or no homework. Our hours were from 7:30 a.m. to 4:30 p.m. each weekday with every other Saturday off.

Again we were directed to General Dickson's office. We were seasoned by this time and fell in with the traditional procedure. We smiled to ourselves thinking of the new class that would get their baptism of fire in that very room four days hence. Now we did not hesitate to smoke and to relax because we all felt that we had been found acceptable.

The talk by the General was about the same length as before. This was a practical talk, on relations with men, production and production methods, the workman's problems, supervision, use of funds, and many other subjects, touched on briefly and pointedly. We were told not to give orders to any workman. We were to ask questions and learn all we could. We were to get our hands dirty and we should dress in appropriate clothing to do any job called for. This was a working course and we were to receive training rather than education.

THE second year passed quickly and with its relative freedom was pleasant. We worked in overalls most of the time, and gained a working and talking knowledge of all things connected with an industrial plant. We saw the General at least once a day, as he visited us wherever we happened to be assigned. He would stop and talk, ask questions, and offer information. This part of the Ordnance School training was his love, and he saw to it that we received the full benefits. We made a number of field trips to manufacturing plants.

IN the spring we went to Raritan Arsenal for Field Service training for ten weeks. This time was taken from the industrial course over the protests of the General but by order of the Chief of Ordnance. I'm not sure that he felt it really was a waste of time, but he had to maintain his stand on the subject.

We found the Field Service very well presented and was one of the best and most useful courses for future years that we took. We visited Picatinny Arsenal and finished up the Ordnance School with a 3-day orientation at Frankford Arsenal.

We had received our orders for new permanent stations before we left Watertown and were all ready to go on leave prior to reporting in to our new stations.

In the mail about two months later each of us who had successfully completed the course received a diploma. It was simple—no ribbons, no seal, no ceremony. It was signed in the firm hand of T. C. Dickson, Colonel, Ordnance Department, Commandant.

To us he would always be "the General." The second year of the school had given us an opportunity of learning a bit more about the General's personal side, which we had not seen while at M.I.T. He knew more about us as individuals, and about our personal problems, than we imagined. He became more the fatherly type of commanding officer, but he never entirely unbent.

He exerted an influence over the thinking and training of more officers of the Ordnance Department than did any other officer. This was appreciated by many of us, and we molded our careers along the guide lines which he established.

The General died in 1936. He was then 67 years old and was the same dynamic, forward-thinking, energetic man we had known, right to the end. He was a leader of men, unorthodox in his methods, fair in his dealings, and unswerving in following the path dictated by his conscience and his thinking.

Above, the T43, the Army's newest heavy tank, is demonstrated for military and civilian officials at the Chrysler Delaware Tank Plant, Newark, Del. Right, the T43 is a far cry from the M3 medium tank of World War II, shown at far right, with its high silhouette and sponson-mounted 75-mm. gun. Below, a T43 moves slowly through the water obstacle during recent tests made at Aberdeen Proving Ground, Md. (Army photo).

Our New Armored Firepower

• The addition of the new T43 heavy tank to the list of combat vehicles rounds out the Army's arsenal of armored firepower. Weighing about 60 tons and armed with a high-velocity 120-mm. gun and caliber .30 and .50 machine guns, the T43 is the largest and most powerful tank ever put into production by the United States.

• Designed by engineers of Army Ordnance and Chrysler Corporation, the T43 is being produced at the Chrysler Delaware Tank Plant.

• Four new self-propelled artillery weapons have also recently been revealed and stand ready to back up America's armored might.

Above, a low front view of the T43 heavy tank shows clearly the single casting used for the hull. The new tank carries a 120-mm. high-velocity gun (Army photo).

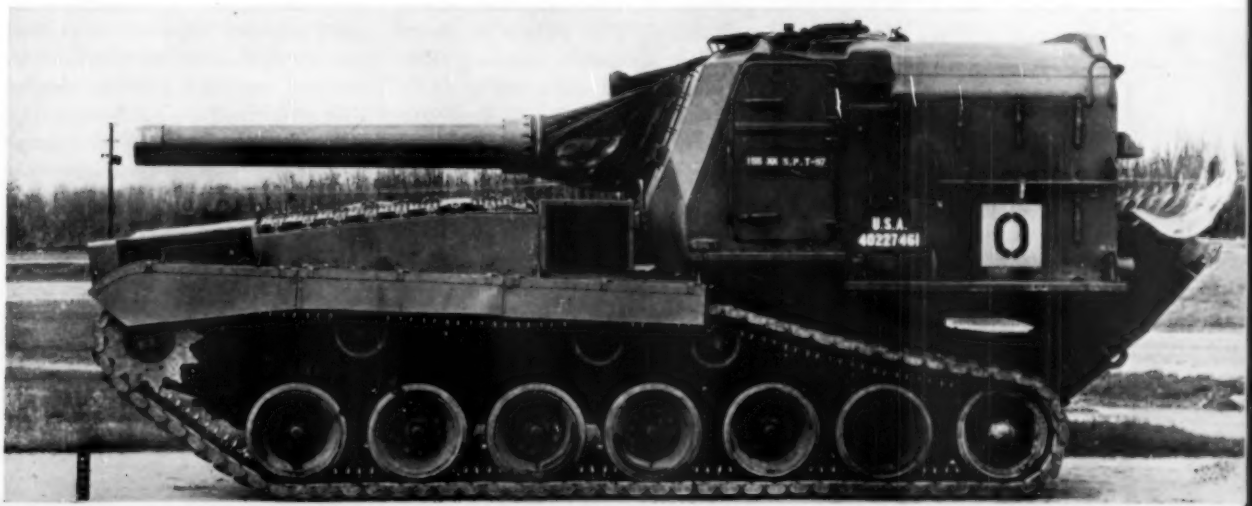
Right, the entire "family" of post-World War II tanks line up at Aberdeen Proving Ground: from left to right, the T43 heavy tank, medium tanks M48 and M47, and the light tank M41 (Army photo). Below, the World War II M3 medium tank at far left is dwarfed behind the M48 medium, center, and the new T43 at far right.

Left, the M42, armed with two 40-mm. guns, is one of the newest items in the Army's collection of self-propelled artillery pieces. Below, the strong "family resemblance" is obvious among the four post-World War II tanks posed together at Aberdeen. From left to right, the T43 heavy tank, medium tanks M48 and M47, and the light gun tank, the M41 (Army photos).

Right, the new T98E1 105-mm. howitzer is a powerful addition to our arsenal of self-propelled artillery (Army photo).

Above, the T108, a self-propelled 8-inch howitzer recently unveiled by Army Ordnance (Army photo).

Right, the tremendous size of the new T43 dwarfs the crewman standing on its turret. The 60-ton tank is shown with its 120-mm. high-velocity gun in traveling position. Below, a recent picture of the new self-propelled 155-mm. gun, the T97 (Army photos).



Guided Missile Production

A résumé of some of the problems encountered in the research, development, manufacture, and maintenance of the latest weapons systems and their complicated auxiliary components and equipment

Lieut. Col. S. M. Smolensky

WHAT about push-button warfare? How far away is it?

I received my original impression of this new era of warfare while watching the first guided bomb move in on us at Anzio in 1944. Then followed reports of V-2 bombings and finally the atomic bomb in 1945. The "push-button" era seemed to be fairly well launched.

Well, here it is 1954. It seems quite appropriate to see what sort of problems the production of these new weapons, the pioneers in push-button warfare, present to us in the Ordnance Corps.

The intent here is to review some of the production problems presented for resolution to the Ordnance Corps as an Army planning and procurement agency and not necessarily all the problems that the contractors must cope with in meeting the program schedules.

As a preface to the production problems, a general orientation of Ordnance Corps organization for guided-missile production is in order. Also, it would appear that a general, unclassified orientation on the make-up of a guided-missile system is appropriate.

IN the guided-missile field we have originated a "system" concept in order to control as closely as possible the development of a highly integrated and complicated system. A guided-missile system, as we now see it, encompasses matériel which is representative of all the commodity classes that the Ordnance Corps procures.

In addition, there are many components and items from the other technical services in the Army and other technical agencies in the Department of Defense. To control the development, production, and distribution of all these components properly, it appears to be most logical to group these major items and major combinations into a family or "system," thus providing us with a project organization permitting great flexibility and control.

Colonel Smolensky has just completed a tour of duty in the National Procurement Division at Redstone Arsenal, Huntsville, Ala. He is currently serving in the office of the military attaché, Belgrade, Yugoslavia.

A typical ground-based guided-missile system, depending on whether it has a surface-to-surface mission or a surface-to-air mission, can generally be broken down into several large functional groupings of matériel.

First, of course, is the missile with its guidance, warhead, propulsion system, and packing. Then there is the ground launching equipment, consisting of the launcher, mechanical handling equipment, mechanical servicing equipment, and essentially the ground mechanical items that are needed to service the rest of the system.

Thirdly, we have the ground guidance equipment which may include radars and other electronic equipment necessary for the guidance system.

In terms of factual data on such a missile system it might be well to realize that as many as twenty to forty thousand drawings may be required. Specifications may run into the thousands.

As far as individual pieces are concerned, a good example is a ground guidance station for one of these systems which contains 1,500,000 individual pieces that must be purchased or manufactured, inspected, assembled, inspected again, and packaged.

Commodities, of course, that go into these systems cut across practically all fields of engineering effort, from the highly complex electronic circuits through various hydraulic mechanisms to straightforward machining operations.

QUITE obviously, these pieces must all be properly tied together to permit the integrated system to work. One of these stations may contain over 30,000 soldered joints whose functioning must be checked and assured.

As for the contractor's standpoint, one of these systems may include 400 to 500 vendors and subcontractors. In many instances, subcontractors or vendors are not even aware of the fact that they are contributing to the systems since all the purchasing and contracting is done by a handful of prime contractors directly responsible to the Ordnance Corps.

These contractors, subcontractors, and vendors are located throughout the country, and we therefore have a good representation in all American industries, large and small.

From the Government-agency standpoint, one of these systems may well involve the interrelationship of twenty to thirty various Government agencies in all segments of the Department of Defense. It is quite easy to see that the attainment of the goals in production of a guided-missile system must stress the "team" aspect.

The above is just a quick glimpse of what sort of a "monster" the simple term "guided-missile system" appears to be. In addition to the programming of a tactical guided-missile system, we must, of course, not lose track of the fact that for each system of this type initiated, a supporting program must be designed to supply the Ordnance maintenance and supply equipment, spare parts, and operating organizations. We will discuss this aspect of the program a little later.

Dollarwise, these programs can account for hundreds of millions of dollars, and the magnitude of such a program, from a dollar standpoint and a contracting standpoint, generates herculean tasks of management and control.

At this point, a quick orientation of the history and organization of the Ordnance Corps production effort might be helpful.

SOME time ago, the Industrial Division, Office of the Chief of Army Ordnance, organized a guided-missile unit to plan production programs, and accelerated measures were taken to promote the production of these missiles. With the uncertainty in the international situation developed by the Korean war, daring steps were taken to promote the earliest possible production of our guided missiles, with the realization and understanding that there would be an overlap between the completion of research and development and initial production.

This "crashing" of production was often referred to as "telescoping" the program.

With the impetus given the production program, the industrial activities soon outgrew the Pentagon staff, and Redstone Arsenal, at Huntsville, Ala., was subsequently designated as the Ordnance manufacturing arsenal with the mission of planning and supervising the guided-missile production effort. While the responsibility was centered here, this did not, by any means, indicate that all the operations would be accomplished here.

The arsenal was assigned the problem of coördinating contractors and Government agencies. In this respect, procedures had to be developed for planning and working closely with Ordnance districts, other Ordnance arsenals responsible for certain commodities in the guided-missile programs, White Sands Proving Ground, Aberdeen Proving Ground, and other technical services in all Defense departments.

Of necessity, this meant close cooperation and teamwork among all these agencies.

Producing these new items has presented Ordnance with many varied, urgent, and interesting problems. There is no intent here to minimize the task of the research and development effort, nor the contractor's production problems, but rather to concentrate essentially on those features of the programs that press the planners in Army Ordnance and other Government agencies.

Probably the most important facet of these programs is the planning and timing the Government experts impose on these projects. A generalization might be made that the contractors usually "come through" with the requirements placed upon them, provided the Government planning and timing are comprehensive and realistic.

The magnitude, complexity, and volume of engineering changes involved require a fast-moving organization to react to the changes and to effect the necessary adjustments.

The "system" concept and the exercising of maximum control over the phasing-in of research and development progress into production by placement of integrated prime contracts is very desirable. Nevertheless, this desirable feature leads to an oversimplified presentation of scheduling and planning data at various Government levels.

For example, if a "system" contains items which are representative of all the commodity classes of matériel that the Ordnance Corps procures, plus some of a number of other Government technical agencies, quite obviously schedule or engineering changes in these integrated systems have the effect of a chain-reaction which generates scheduling, design, or coördination problems involving numerous individuals and Government agencies.

Time lags are necessary both to study the effect of the change and to implement corrective action. Suggestions to improve these conditions follow this pattern: (1) Improve communications, (2) Orient planning personnel at all levels, (3) Improve planning techniques, methods, and reporting systems.

RESEARCH and studies to improve planning techniques and controls have been initiated, but much remains to be done.

The suggestion to improve communications between all planning personnel brings us immediately up against another tremendous problem—that of "security." Technical data and information must be protected, and effective security control is necessary.

But where does this put the poor guided-missile planner? The programs have tight schedules, with changes being introduced which require expedited action. The telephone cannot be used; telegrams must be cryptographed; and letters thoroughly screened, documented, logged, and receipted for. The volume of letters, reports, drawings, and technical data may amount to more than 100,000 actions a month.

Suggestions to bring security data transmission methods and control procedures in line with the speed of this "electronic age" point to top level Government research into possible application of statistical quality control techniques to improve reliability of security measures, investigations into use of TV techniques, microfilm, business machines, or development of electronic devices to accelerate transmission and recording of technical data.

The problem of improving techniques on the part of Government planners appears to be a fruitful field which

should receive the attention of key individuals in all Government planning levels. Suggestions have been made to review, establish, and publicize planning authority and responsibility for various phases of these programs at appropriate Government levels and agencies.

The suggestion has also been made to devise a reporting procedure which would be tailored for the planning level concerned but would also contain information on what details or supporting programs have been omitted or might be effected by any revisions in the report concerned.

Another major problem these programs present is that of the extent of Government supervision to be applied to the coördination and administration of these contracts. The policy within which these programs operate is that of attempting to minimize the amount of Government personnel required for such administration—the emphasis being on passing on, as much as possible, these management, control, and coördination aspects to the prime contractors.

NEVERTHELESS, in spite of this objective, there still remains the requirement of coördinating the efforts of a number of prime contractors and also attempting to maintain within the Government certain controls with respect to implementation of engineering changes, changes to contracts, and inspection of the articles produced.

What should remain within Government control is a problem worthy of considerably more investigation, discussion, and analysis on the part of Government planners. There are rather detailed statistics regarding the engineering force available within industry to perform these various programs.

However, very few data are available to point out what ratio of Government personnel must be applied with respect to contractor personnel to determine the adequate minimum requirement. In this respect, Government supervision is essential to effect the solution of certain problems which are purely of a governmental interest, such as nomenclature, cataloging efforts, engineering change-order implementation, packaging, safety, Government-furnished equipment, implementation of field modifications, development of adequate tests and inspection of equipment, plus Ordnance equipment for the support of the tactical equipment.

With respect to Government supervision, a very serious problem exists in terms of personnel. A program of this type requires rather specialized backgrounds, and there is a lengthy learning curve that applies before personnel can be used adequately.

The problems enumerated above, which are of peculiar Government interest, are all problems which are common to other Ordnance matériel. However, with respect to the guided-missile program they become acute problems because of the magnitude, interrelation, and accelerated schedules of the guided-missile systems.

With respect to nomenclature—the problem here is properly to designate a number of major items, and in the case of one guided-missile system it may well amount to over one hundred different nomenclature entries. These all must be properly screened against existing nomenclature lists, approved by a number of committees, and model and type numbers applied.

Difficulties that arise here are due to the fact that the routine for approving nomenclature is of necessity a rather elaborate one, and time-consuming. On the other hand, the data necessary for the generation of nomenclature are not readily available until the designs are far enough along in terms of appropriate drawings to be able to effect a detailed study.

QUITE often, then, the matériel is in the process of being delivered before the nomenclature has been finalized. However, having nomenclature properly established at an early date in the program is of great significance in permitting an orderly development of the necessary publications required for the operating and maintenance personnel, and for the generation of required spare-parts and packaging lists.

The publications problem alone is one that requires constant attention. Here again it is easily seen that such operating and maintenance manuals of necessity must be available when the equipment is delivered to the field forces. On the other hand, it probably can be easily understood that such manuals cannot be properly written up until the matériel has been well defined.

With continuous changes creeping into the designs, it is quite natural that the publications must be designed in such a way that this revision can be continuous. This situation has resulted in our promoting an interim publication format, rather than going into the formal type of publications.

Many of you have probably read about the Department of Defense cataloging program, the aim of which is to minimize the number of items that must be procured by the Department. In the guided-missile business we, of course, fall within this program and have set up procedures to minimize the procurement of new or specialized types of items or components if there is any possibility of a suitable item being available within current military supply channels.

TO do this, however, requires a detailed spelling out of each piece that goes into a guided missile. It means an adequate description of the item, with enough data being furnished the Government agency to permit a screening against available catalogs.

The problem is not a difficult one, except of course for the magnitude, and that is where we have our troubles. A guided-missile system may have from twenty to thirty thousand spare parts in it. Screening of that amount is obviously a large job. Add to this the effect of changes being introduced and it is evident that the screening operations can be multiplied by several magnitudes. Progress is being made in establishing electric accounting procedures to accelerate this program.

Parallel to the cataloging problem is, of course, our Government-furnished equipment problem. As the various parts lists are screened against items available in the military supply channels, we attempt to acquire these items from other technical agencies within the Department of Defense and phase them into the deliveries at the contractor's plant. With the twenty to thirty

other Government agencies involved, the large number of components, and the introduction of engineering changes, the expediting-coördinating problems keep the guided-missile planner in a state of nervous exhaustion.

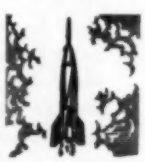
HERE again the lead-time factors have to be very carefully watched and other Government agencies required to meet their commitments. The problem is not insurmountable, but it does demand a lot of minute, detailed, and integrated planning in its control.

Following the above program is the very important packaging problem. Here we have a field where great savings can be made—or costly operations performed if the packaging is not properly planned and controlled. The type of packaging has to be determined, and the spare parts must be grouped into unit packs and overpacks.

We have here a problem of adequate description, parts numbers, and stock numbers, and all this information must be generated in sufficient time to be available for the contractor to phase in with his delivery schedules and to prevent undue accumulation at the contractor's plant.

Control of engineering changes is particularly important with respect to the spare parts packaging program. Here again with respect to packaging we do not have a new problem as far as Ordnance is concerned but one where the sheer volume and magnitude requires extremely detailed planning to prevent unnecessary costs.

Perhaps the most pressing problem that affects the guided-missile planner is the matter of safety. We are dealing, on one hand, with an entirely new item of Ordnance matériel which uses in some cases highly hazardous and toxic liquids which require particularly careful handling.



On the other hand, we have the pressure of accelerating production and striving to obtain early deliveries of the equipment to the field. When the time arrives for the release of this equipment, the individuals involved in assessing its acceptability from a military safety standpoint are under tremendous pressure in trying to determine whether a sound decision has been made.

The easiest approach, of course, would be not to release anything for tactical use until it has had a long-term test evaluation and surveillance, but this would preclude meeting any of the crash schedules. Somewhere in between, the best available technical data must be assessed and a reasonable calculated risk taken.

This problem of assuring the safe operation of equipment is not a new one to the Ordnance Corps, but the decisions as to safety must be made at perhaps an earlier time in guided-missile programs than in other development items.

"Perhaps the most pressing problem that affects the guided-missile planner is the matter of safety. We are dealing . . . with an entirely new item of Ordnance matériel which uses in some cases highly hazardous and toxic liquids which require particularly careful handling."

Much has been said about the numerous changes that are constantly flowing into the system as a result of the progress being made under the research and development projects. The implementation of these changes is done under the engineering change order procedure.

Here we have the situation of trying to keep the production schedules moving and at the same time attempting to introduce changes on a very expedited basis. The procedure set up here is essentially one of permitting the utmost flexibility while still attempting to maintain a proper record and control of the introduction of these changes so that their effects can be carefully studied and implemented with respect either to packaging, spare parts, or field modifications.

In this regard the grouping of such changes becomes more and more important once the equipment has started to be released to the field.

Once in the field, the equipment is no longer under the control of the production organization, and the interjection of the engineering changes that may affect equipment already released necessitates the establishment of a field modification program.

Here we have the complicated problem of knowing which items must be modified, where they are, and getting to the equipment the appropriate field modification kit which must be applied, together with the proper spare parts and attachments which can replace the components for which intended.

All of the above items are items which the Government experts have to think about with respect to tactical equipment for the field forces. In addition, we must adequately plan for test and inspection equipment, and equipment required by Ordnance units which will support and maintain the field units. Here the problems are really accentuated by the telescoped nature of the programs.

The systems being planned and projected for immediate field use upon production preclude any long-range program to develop the proper test and supporting Ordnance equipment. These decisions have to be made and the equipment planned for before the first matériel is delivered.

IT can be readily seen that the final decisions as to the type of test and maintenance equipment needed cannot be determined until the designs for the tactical system have been finalized and until the various publications and spare-parts lists involved have become relatively firm.

As a result, the test and Ordnance maintenance equipment and tool lists are bound to be in a state of continuous change and turmoil for some time to come.

The above are merely the highlights of the problems that present themselves to the Ordnance Corps, but I believe they do point out the magnitude of our programs. Perhaps this discussion will help promote better understanding among all concerned as to the problems that must be solved before these programs can be run on a routine basis.

Month by Month: Highlights of the National Defense

Thirty-sixth Annual Meeting

The Thirty-sixth Annual Meeting of the American Ordnance Association, described in detail elsewhere in this issue, was held at Fort Worth and Carswell Air Force Base in Texas on May 6th and 7th.

The meeting was a tribute to our Air Force. The theme of the meeting was "Air Armament—Key to Air Power," and the hope was expressed that, as a result of deliberations during the two days, the strength of American science and industry, as represented by the American Ordnance Association, would be able to give added assistance in bringing about matchless air power for the security of our country in the atomic age.

By invitation of Harold E. Talbott, Secretary of the United States Air Force, the Association was privileged to hold its annual meeting in coöperation with the Air Force and to visit Carswell Air Force Base. Mr. Talbott's gracious invitation emphasized the important bond between the Industry-Ordnance Team and the Air Force.

The 2-day meeting stressed the well-known principle that to control the air for our national defense means that our military aircraft must be equipped with the best of armament. It is the function of the American Ordnance Association to assist, as a member of the team, in meeting this goal at all times and without challenge.

Grateful thanks were also expressed to Gen. Curtis LeMay, Commander of the Strategic Air Force; to Lieut. Gen. Emmett O'Donnell, Jr., Deputy Chief of Staff, Personnel, whose splendid address appears elsewhere in this issue; to Maj. Gen. J. B. Montgomery, Commander of the 8th Air Force, Carswell Air Force Base; and to Brig. Gen. Leighton I. Davis, director of development, Air Research and Development Command, Baltimore, Md.

Members were reminded that the Ordnance Association performs a voluntary service to our armed forces through its Technical Divisions and Committees. These Divisions and Committees consist of many of the leading engineers and executives of American industry who make available, entirely without cost, their skills and counsel for the production engineering of all types of ordnance and armament for our Army, Navy, and Air Force.

This year's annual meeting was an appropriate occasion to offer again the facilities of the Association—35,000 strong—to the Air Force with assurance that its services are available at all times for the development and production of superior armament for air defense.

Such a pledge was given by Lieut. Gen. Levin H. Campbell, Jr., who, as president of the Association, presided at the Fort Worth meeting. And it will be echoed by the Association from coast to coast.

Navy Organization

The report of the Committee on Organization of the Department of the Navy has been submitted to the Secretary of the Navy Robert B. Anderson.

The committee came to the conclusion that the organization of the Navy is basically sound.

The few specks of dust that the committee was able to find on the Navy's proud escutcheon included the need for certain clarifications and reassignments of responsibilities. Especially is this so, in the committee's opinion, regarding the authority of civilian executives.

The committee's second suggestion was that the Under Secretary of the Navy should be designated in charge of business and production activities.

The final hint was that two new Assistant Secretaries should be authorized and designated.

All in all, a very flattering report—and deservedly so!

Andrews Laboratory

The Andrews Engineering Building, in honor of a great Air Force leader, the late Lieut. Gen. Frank Maxwell Andrews, was dedicated recently at the Air Force Armament Center, Eglin Air Force Base, Fla. General Andrews' untimely death early in the Second World War deprived our fighting forces of one of its best air power pioneers.

The memorial address was delivered by Maj. Gen. H. J. Knerr, also a distinguished air-armament specialist.

"This building," he said, "is a particularly fitting memorial to General Andrews in that it is an instrument to facilitate the exercise of foresight in the development of our armament. If, with the meager means available to him in his time, he was able to penetrate twenty years into the future so successfully, how much better you are prepared to do likewise in your time.

"I commend to you General Andrews' favorite quotation from General Douhet: 'Victory smiles upon those who anticipate the changes in the character of war'."

Radford on Varied Defense

Adm. Arthur W. Radford, Chairman of the Joint Chiefs of Staff, recently gave the statesmen a briefing on the world situation.

He told the Senate Foreign Relations Committee that the Nation's defense plans were not based on the belief that ability to deliver massive atomic retaliation was in itself adequate to meet all our security needs.

The admiral's words had all the ring of a state paper of top importance.

"In view of our vast industrial capacity, technological ability, and limited manpower," Admiral Radford said, "we believe that our most effective contribution consists of complex technical weapons and equipment, modern air

and naval power, and highly mobile offensive combat forces backed up by ready reserves, not for any one date but for now and the indefinite future.

"On the other hand, we feel that the other free nations can most effectively provide in their own and adjacent countries the bulk of the defensive ground forces and local naval and air power."

Nike Antiaircraft Defense

The Army has completed plans for the construction of forty Nike guided-missile antiaircraft installations for the protection of a number of critical defense areas.

The project will take two years to complete and will cost $75,000,000. Harassed taxpayers that we all are, some of us should sleep better in 1956 if we live in the following areas: New York, Washington-Baltimore, Philadelphia, Boston, Norfolk, Cleveland, Chicago-Detroit, Colorado Springs-Denver, Hanford, Seattle, Los Angeles, San Francisco, and one unnamed site.

Each defense area will have up to 4 Nike battalions, each consisting of 448 persons and 4 batteries.

The installations will be constructed to last at least ten years. The Army feels that by 1966 present-day guided-missile operations will be supplanted by something better.

Offshore Procurement

Our Government shouldn't buy war goods abroad when American companies are suffering from a shortage of defense or other business.

This is what businessmen are telling Congress and the Pentagon. Ailing industries are making a dramatic fight for the $1.2 billion of war goods orders now scheduled to be placed in foreign countries in the near future.

During the past two years we have channeled over $2.2 billion in defense contracts to foreign firms making ammunition, electrical equipment, cars and trucks, small boats, tanks, airplanes and parts, and other goods.

The general idea—and many critics claim that it was not a very bright one at that—was to boost defense production capacity abroad, spur lagging economies in Europe and elsewhere, and stimulate foreign trade by providing foreign nations with American dollars.

Now that certain American firms are reaching for the red ink, they want very much to be remembered when profitable contracts are about to be awarded to distressed industries.

Long-Pull National Defense

Quite an argument is shaping up over the "long-pull" concept of national defense as contrasted with the "massive retaliation" policy.

A prominent statesman expresses the view that the latter policy is not fitted to meet local aggressions like the one in Korea. He raises the question whether it would not leave this country only two choices: touching off a "thermonuclear holocaust" or letting the Communists get away with local aggressions.

Charles E. Wilson, Secretary of Defense, a "long-pull" champion, states in his semiannual report that United States strategy was aimed at handling little aggressions as well as big ones.

"The new long-range guidelines for the military security of the United States," he said, "place increased emphasis on land- and carrier-based air power and on the integration of new weapons into our strategy and tactics. At the same time, they provide for the maintenance of strong, well-trained, and well-equipped ground and naval forces."

Mr. Specialist

The Defense Department announced that the 1955 Army would begin an intellectual exercise of unusual magnitude. It will begin to draw a distinction between noncommissioned officers and technical specialists.

Today all specialists, as well as men serving as leaders or supervisors, are considered noncommissioned officers.

Under the new order, those men who actually serve as leaders or supervisors will retain the old designations of corporal and sergeant. Their titles and insignia will remain unchanged.

Men who perform nonleadership duties will get new titles and insignia. They will rank as master specialist, specialist first class or second class, or simply specialist.

There will be no change in pay or other benefits as a result of the new operation. But its always good to see a specialist come into his own.

Involuntary Service

Although some men may not like it, active-duty Reservists may be required to serve involuntarily in the Reserve and National Guard.

Assistant Secretary of Defense John A. Hannah disclosed that he has asked the Attorney General two heavy-duty questions affecting a new Reserve training program which Congress, we presume involuntarily, will be asked to consider.

Ready for the questions?

1. Does Congress have constitutional authority to assign Reservists involuntarily to the National Guard program?

2. Can men be drafted for six months' training and then be required to serve in the Reserve units or the National Guard for an extended period of training?

Secretary Hannah told the Senate Armed Services Committee that detailed plans to strengthen the Nation's inadequate Reserve forces will be presented to the National Security Council when two answers are received to two remarkably clear questions.

More or Less Men

Here we go again. The question is whether modern weapons will require greater battlefield dispersion of troops —and hence more of them.

Gen. Charles L. Bolte, Vice Chief of Staff, recently spoke up for the affirmative.

Modern weapons, he maintained, will demand greater dispersion of units on the battlefield. It would certainly be silly to mass our manpower where they could easily be knocked off by atomic weapons of the enemy.

"The greater area of the battlefield will in turn require larger numbers of men," General Bolte said. "Thus, even though the men are more widely dispersed and in smaller units, they will still be needed in great numbers, and there is nothing to indicate that the demands upon our manpower will be lessened in any future war."

More technology, more men. If this sort of thing keeps up, we may soon run out of technology.

A-Gun Power

Gen. Matthew B. Ridgway, Army Chief of Staff, recently declared that the Army's new atomic cannon can fire a shell with nearly as much destructive power as the atomic bomb that was dropped on Hiroshima toward the end of World War II.

General Ridgway also disclosed that Army units will soon get new guided missiles and rockets which will further increase their ability to concentrate long-range firepower on enemy targets.

The Army is making great efforts to increase both mobility and flexibility in order to be able to attack and defend under conditions of atomic warfare.

The size of Army divisions may be cut to permit greater dispersion and thus offer smaller and more widely scattered targets. Dispersion is the big problem. If we are wise we will leave no stone unturned to bring it about all up and down the line.

Exercise Flash Burn

Television was used in the main phase of Exercise Flash Burn, one of the largest Army maneuvers ever held in this country.

You can no longer escape TV—even on a battlefield.

Sixty thousand troops and several hundred aircraft demonstrated the power and efficiency of new atomic weapons in the Fort Bragg-Camp Mackall area of North Carolina.

TV has tactical significance. TV cameras broadcast maneuver battle scenes direct from trucks near the front lines and from liaison aircraft to command posts.

Some of the Army's latest weapons, including the heavy Honest John artillery rocket, the Corporal guided missile, and the 280-mm. atomic cannon, were employed with excellent results.

The maneuvers also demonstrated the increasing airlift capabilities of the United States. Giant troop transports brought 7,000 men 900 miles to Exercise Flash Burn.

Operation Clean Sweep

Spring is the season for auction sales. Everybody buys a new car, a used car, or a surplus military item.

Military surplus sales this year, it is estimated, may bring in, more or less, give or take a dollar, about $200 million.

The Army never had it so good in this atomic era of frustrating economy.

Not only are auction sales being given a profitable whirl but negotiated sales will also be tried.

These disposals, in case you didn't guess, are part of the inventory modernization program which the Defense Department sponsors. But be careful, friends. Don't reduce the on-hand stocks of critical weapons. They don't grow on trees and the longer they take to make the harder they are to get when you need them.

Ordnance in Korea

"An ounce of prevention is worth a pound of cure."

This famous little quotation is being pounded or infiltrated into the minds of the student officers who are attending the M-series Preventive Maintenance Course at the 32nd Ordnance Battalion, Pusan, Korea.

Each Monday and Thursday a new group of officers from the Korean Communications Zone starts the 3-day class which consists of twelve hours of lectures, six hours of demonstrations, and a like number of hours for practical exercise periods.

"Each individual must realize that a vehicle costs a considerable sum of money," said Lieut. James C. Streicher, Detroit, Mich., the chief instructor.

He added that each soldier should give it (the Army vehicle) the same care he would give his own car. Good advice wherever given, whether in Korea or in South Parking. Keep up the good work, Lieutenant!

Industrialists Honored

John Slezak, Under Secretary of the Army and a director of the American Ordnance Association, was one of six leading engineers and industrialists, all of them graduates of the University of Wisconsin, who were cited for outstanding accomplishments in their fields at the annual Wisconsin Engineers' Day observance on the campus, Friday, May 7, 1954. Others honored on the same occasion were:

Arne J. Asplund, president, Difibrator Corporation, Stockholm, Sweden;

Adolph J. Ackerman, consulting engineer, Madison;

Mack C. Lake, formerly president and now consultant of the Orinoco Mining Company, New York;

David W. McLenegan, manager of technical personnel and education of the Hanford Atomic Products Operation of the General Electric Company, Richland, Wash.;

Robert C. Siegel, chief engineer, Wisconsin Telephone Company, Milwaukee.

Secretary Slezak was born in Czechoslovakia and came to the United States in 1916. He was graduated from the University of Wisconsin in 1923. He served in both World Wars I and II in the Ordnance Department of the Army and continued to serve in the Army Ordnance Reserve between the wars. He was chief of the Chicago Ordnance District for forty-seven months during the Second World War and was a consultant to the Army and Navy Munitions Board in 1947.

Colonel Slezak was named Assistant Secretary of the Army in 1953 and since early this year has served as Under Secretary. Before coming to Washington he was president of the Turner Brass Works, Sycamore, Ill.; president and chairman of the Pheoll Manufacturing Company, Chicago; and a director of the Felt and Tarrant Manufacturing Company, Kable Brothers Company, Illinois Bell Telephone Company, Burgess-Norton Manufacturing Company, and Infilco, Inc., in Chicago.

Armament Research

An Editorial

OUR very strong position in science and industry is one of the main defensive bulwarks of this country.

One of the revolutionary developments of World War II was the emergence of science and technology to a primary rôle in shaping the character and outcome of warfare. The rise of air power to a dominant position among the military forces was a part of the revolution in military science, but the revolution was much broader than airplanes; it affected all arms and all weapons systems.

The development of radar, proximity fuzes, precision fire-control systems, and the atom bomb was a major factor in winning the war. Scientific results were quickly put into practical military use. The United States was a leader and continues to lead in this technological revolution.

Addressing an Armed Forces Day Dinner in Atlanta, Donald A. Quarles, Assistant Secretary of Defense (Research and Development), remarked that, in order to insure and guarantee this technical leadership, we must continue to have a sound military research and development program.

"This year," he said, "the Department of Defense is spending for research and development about $1.3 billion, the highest level of such expenditure in our history. This is about 2½ times the average research and development expenditure in the years immediately before Korea, when the level ranged around one-half billion dollars a year."

Such boom-and-bust, or feast-or-famine fluctuations are unwise on two counts:

First, we paid a heavy penalty in the initial inefficiency of our research and development work that was suddenly speeded up to meet the challenge of the Korean crisis.

Secondly, we took chances when we tried to produce large quantities of war matériel for Korea that had not been completely developed. It is a grievous error to put an unproved weapon into quantity production.

RESEARCH and development programs, any more than production programs, cannot be turned on and off like faucets. If they are not maintained on a high, consistent, and constant level of efficiency by adequate appropriations, no amount of bureaucratic desk-thumping can regain the golden opportunities of a slowdown yesteryear nor recapture the lost laboratory and field-testing hours that might have given us ready-to-go preparedness.

But Mr. Quarles assures us that we have, at long last, learned our lesson.

"The present program," he declared, "taken together with the military-related programs of the Atomic Energy Commission, accounts for about one-half the total research and development under way in the United States. As important as this work is to the security of the country, I doubt that we could devote a very much higher fraction of our research and development effort to defense without damage to the essential civilian economy and the long-term welfare of the Nation."

The budget now under consideration by the Congress for the next fiscal year cuts back the present level of expenditure by about ten per cent. Recent events in such diverse areas as Indo-China and Guatemala scarcely warrant a great deal of optimistic economy. As Mr. Quarles properly points out, there is no prospect for the kind of peace that would justify letting down our guard.

The obvious task of our Defense Department is to get substantially full value in research and development from the moderately lower expenditure level. There must certainly be no letdown in our preparation for the long pull.

"Realizing how quickly things will happen in the next major conflict," Mr. Quarles asserted, "it is apparent that we must perfect the most modern and effective weapons now and have them ready in our arsenals and in the hands of our troops before war starts. We must realize that we will never again be allowed the time for orderly build-up from a peacetime to a war footing."

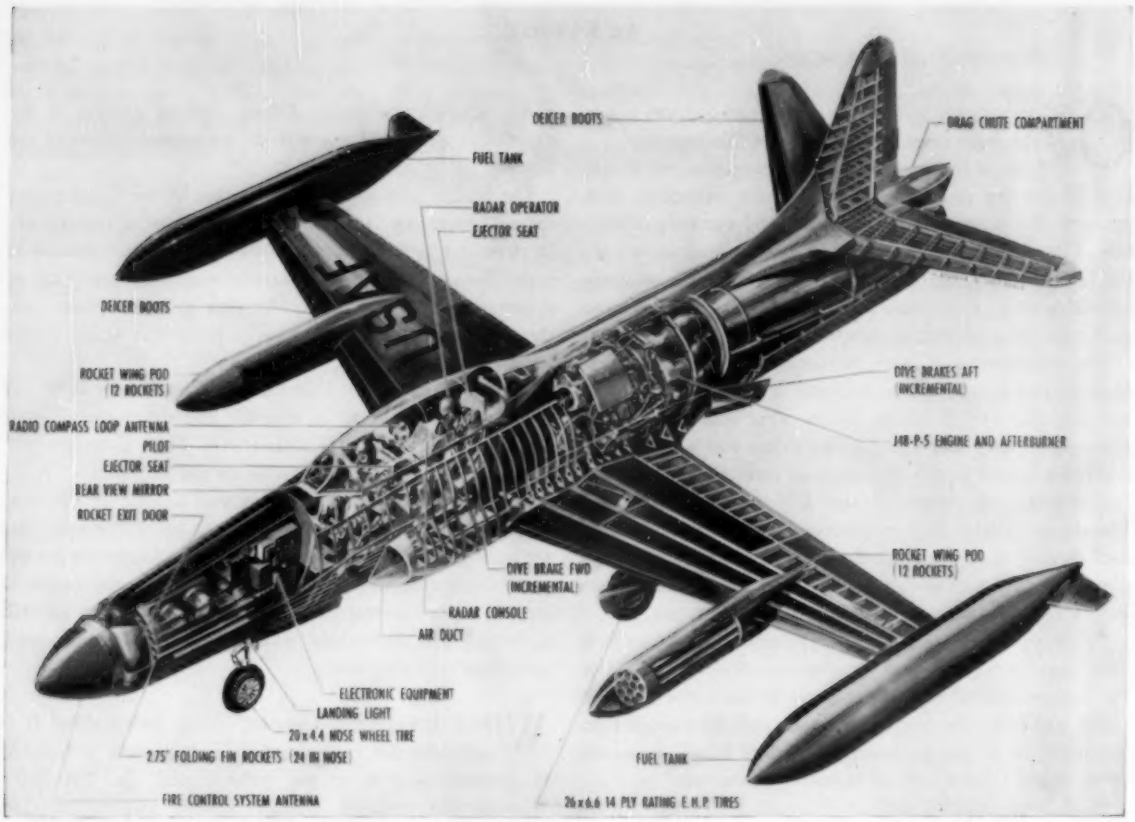
WHAT is apparent, however, is not always done. It is apparent, for example, that basic research is essential to genuine progress in our technological age. Yet Mark Watson, distinguished military analyst, recently charged that, in postwar military research, we are still dragging our feet. We are appropriating much less than our scientists are seeking. All the mechanisms for research are not fully employed, and we are not outstandingly proficient, so Mr. Watson alleges, in planning research projects at a high level. In short, we tend to favor those projects which show a lively promise of results.

It may be argued that we are fully capable of producing more new weapons than we have thus far introduced for use on the battlefield. At the same time, we can take legitimate pride in the whole family of new atomic-age weapons that we have pioneered.

The 280-mm. gun, already in Europe, can pin-point targets at twenty miles. The Honest John rocket requires no special emplacement and its launchers are even more mobile than the 280-mm. gun. The Corporal, a surface-to-surface guided missile, rounds out the atomic ground weapons.

Continuing high-quality research is essential in all fields—ground, sea, air, and underwater. There must be no complacent slackening of effort. In this important area of national defense the American Ordnance Association can be counted on, as in the past, to contribute its best and finest resources, through its highly efficient Technical Divisions, to the unending task of keeping America in the forefront of military technology.

Aërial Striking Power



The cutaway drawing of the Lockheed F-94C Starfire jet interceptor, above, shows how the forty-eight 2.75-inch rockets are carried in nose tubes and wing pods and the stowage of the 1,200 pounds of electronic equipment. The new M39 automatic 20-mm. aircraft cannon, below, has a higher cyclic rate than any other aircraft gun now in operation (Air Force photo).

Reg. U. S. Pat. Off.

INDUSTRIAL PREPAREDNESS

a monthly report on current scientific and logistical developments as they relate to the armament preparedness

This bulletin appears regularly in ORDNANCE. In the months in which the magazine is not published this bulletin is mailed directly to the members of the Technical Divisions and Committees of the Association

No. 93 July 1954

● **The establishment of an "American theater"** under a single, powerful commander with responsibility for continental defense is being considered by our highest military and civilian authorities. The commander would have authority over all Air Force, Army, and Navy units allocated to defense of the U. S. against attack.

Defense Secretary Charles E. Wilson said the move, long advocated by some military men and opposed by others, "hasn't been decided."

Criticism of present methods of defense is not new. Last June a special committee told Mr. Wilson that "the complex operations of continental defense against air attack suffer throughout from lack of clean-cut organization."

Under the present setup there is an Air Defense Command operated by the Air Force. The Army has an Antiaircraft Command, responsible for artillery and missiles around industrial centers and under the "operational control" of the Air Defense Command.

The Navy, whose continental defense rôle is increasing, is on its own, so to speak, but "coördinates" with its sister services. The Navy is reported not to favor the idea of an "American theater" commander to whom it would have to allocate specific forces, relinquishing its own control over them.

There are two main continental defense organizations under study:

1. A huge unified theater under a single commander, like those in the Far East, Alaska, and the northeast from Labrador to Thule, Greenland, with air, ground, and sea forces at his disposal.

2. A less ambitious project to make the Air Defense Command a specialized organization directly responsible to the Joint Chiefs of Staff as the Strategic Air Command is now.

● **At about the time** he relinquished his post as Assistant Secretary of Defense (Supply and Logistics) to become the Secretary of the Navy, the Hon. Charles S. Thomas outlined in a briefing session at the Pentagon the tremendous advances being made by the Department of Defense in applying modern supply methods to "the biggest business in the world."

Secretary Thomas stated that the Defense Department is working to gear its supply system to this Nation's modern production plant.

"If, overnight, we should devote all our economy to war production, the output would be staggering," Secretary Thomas noted. "We want to be able to take advantage of that production."

One effort to improve supply is centered on development of a basic system of catalogs for military end items. Now there are 4.5 million items. Secretary Thomas hopes the list can be cut to around 1.5 million. When perfected, the new catalogs will give each military item a single stock number, where now some items have as many as 400 stock numbers. He emphasized it would take several years to complete the numbering system.

Previous efforts aimed at a single catalog of military goods led to the "most maladministered program I have ever known," Secretary Thomas charged. He said the advocates of the single catalogs were wrong on three counts—that it would be useful, that it could be prepared by 1954, and that it would save four billion dollars a year.

While there is to be one stock-numbering system, Secretary Thomas explained there will be several catalogs, one for the items that all the services use, others for items used by two services, and still others for the 60 per cent of all military items that are used by only one of the services.

Secretary Thomas said that another major effort is centered upon standardizing military equipment. He said that in Korea he saw the armed forces using 25 different makes of cranes and 23 kinds of power shovels. He said that the list of 74,000 different bearings used by

the armed services has been cut to 21,000 and will be further cut to between 5,000 and 7,000.

Five thousand different kinds of electronic tubes were being used, and this number will be cut to about 190. The list of 800 different screwdrivers is being cut to about 100, and the variety of ski poles is being trimmed from 25 to one.

A by-product of a more efficient supply system, said Secretary Thomas, is expected to be a less costly accumulation of surplus material and a more orderly surplus-disposal system. He said civilian specialists will be assigned to the surplus program, with special training and some yet-to-be-developed incentive system for helping to keep the surplus moving, and a 10-member advisory group will be set up to help.

● **The signing of the Air Academy Act** by the President marks the end of the first phase in the establishment of a professional academy to supply a nucleus of officers trained intensively and specifically for lifetime careers in the Air Force.

Since 1949 the Defense Department has maintained the position that an Air Academy was the solution to the Air Force's need for professional air officers.

This position was endorsed by a Service Academy Board in 1949 headed by Dr. Robert L. Stearns, president of the University of Colorado. Vice-chairman of the board was General Eisenhower, then president of Columbia University. Other more recent studies by educators have upheld the position.

The establishment of the Air Academy will serve a number of important purposes:

1. It will eliminate the drain on the Military and Naval Academies which heretofore have had to furnish 25 per cent of their graduates to the Air Force.

2. The number of officers obtained from these two sources is not enough to maintain an adequate corps of career-minded officers in the Air Force. Top-notch graduates of civilian colleges are normally not interested in the lesser financial attractions offered by careers in the Air Force. The Air Academy will supply these officers.

3. It will furnish air-minded and air-experienced officers with training in Air Force specialties rather than Army or Navy specialties.

4. Approximately 1,200 Regular officers must be taken into the Air Force annually. All studies of Regular officer needs for all three services reflect the belief that 50 per cent of the Regular officers should be service-academy graduates with 50 per cent coming from civilian colleges. It is impossible to meet these quotas with the two existing academies.

5. The training program will enable the Air Force to establish and enforce the highest standards of loyalty, integrity, and patriotism, and to motivate its cadets to a lifetime of service in the armed forces.

6. It will provide a source for large numbers of Regular officers who will eventually be specialized in both pilot and aircraft observer positions. There is an increasing need for such flying officers in the Air Force in both fighter and bomber-type aircraft.

7. The intangible but invaluable factors of morale, *esprit de corps,* and devotion to the service resulting from the establishment of the Air Academy will inevitably contribute to the effectiveness of the entire Air Force.

Secretary of the Air Force Harold E. Talbott has appointed a 5-member commission which will recommend a site for the new Air Force Academy.

The three civilian members are Virgil M. Hancher, president of the University of Iowa; Merrill C. Meigs, vice-president of the Hearst Corporation, Chicago, Ill., and during World War II, senior consultant on aviation in the War Production Board; Charles A. Lindbergh, whom President Eisenhower nominated recently to be a brigadier general in the Air Force Reserve.

The military members include Gen. Carl A. Spaatz, U.S.A.F., Ret., first Chief of Staff of the Air Force; and Lieut. Gen. Hubert R. Harmon, special assistant to the Chief of Staff for Air Force Academy matters.

● **The Bureau of Supplies and Accounts,** Navy Department, announced it would establish a course in Supply Management pointed primarily at the responsibility level of commander and captain.

It will be given in resident form at the Navy Supply Corps School, Athens, Ga., through the Correspondence Course Center, Brooklyn, N. Y., and will be made available to inactive Reserve officers in resident form in the various Navy Reserve Officer Schools.

It is planned that this course will be used to provide an area of exemption from examination for promotion to the grades of commander to captain.

Bureau of Supplies and Accounts officials expect that the course will be instituted no later than January 1955.

● **More than 900 persons with college degrees,** of which number approximately 200 have masters degrees and a dozen or so Ph.D's from American and European universities, are pooling their mental resources at the Army's Redstone Arsenal, Huntsville, Ala., in developing new wonder weapons with emphasis on rockets. The group includes noted American missilemen and scientists and most of the top-level Germans who developed the V-2 rocket. The fruits of their research and development will enable America to play a tremendous rôle in the event of future war.

In fact the Army feels that the accumulated specialized knowledge held by these scientists, chemists, physi-

cists, mathematicians, and military experts probably is unequaled anywhere in this country today.

Furthermore the statistics reveal that 20 per cent of enlisted privates there are college graduates and 85 per cent have high-school graduation certificates. These figures include cooks, guards, and truck drivers as well as chemists and mathematicians.

● **The top-secret intelligence outfit** of the Defense Department—the National Security Agency, will start moving to Fort Meade, Md., next January. The agency, which now operates from scattered buildings and barbed-wire-enclosed areas in and around Washington, concentrates on monitoring all electronic communications.

Construction of the agency's new headquarters has been under way for some time and is scheduled for completion in 1956.

● **The Defense Department recently announced** it has worked out a new agreement with the General Services Administration designed to speed the disposal of surplus military-owned supplies and equipment.

Henceforth, the Pentagon said, all items which are reported to GSA as excess to military needs will be automatically released for sale after 90 days, with the exception of office furniture, which will be held for 120 days. Purpose of the time period is to allow GSA to "screen" other Government agencies on the chance they might want the property. Up to now there has been no limit on the amount of time which might be consumed in the screening process by GSA.

The Pentagon also announced that 11 categories of excess material will no longer be reported to GSA, including shoes, electronics equipment, old auto parts, textiles, machine tools, and similar equipment for which there is relatively little nondefense demand. Up to now these items were reported to GSA and given a 75-day screening.

Defense officials believe the new procedures will cut from 75 to 80 days from the time required in disposing of military surplus items.

● **The Pentagon** is getting ready to issue new orders laying out a uniform, department-wide policy on the allowance of rapid depreciation of defense production facilities in figuring costs of defense contracts.

The new orders will be of importance to every manufacturer producing goods for the Defense Department under negotiated contracts. They also will be significant for those contractors who have completed their orders but who want a readjustment in their allowance for depreciation costs.

For more than a year, the military services have been allowing manufacturers "true depreciation" of tools and equipment used to make guns, aircraft, ammunition, and similar items. But there has been one big hitch: The services can't agree among themselves on what constitutes "true depreciation."

Here's how it works: An aircraft manufacturer who gets an Air Force order for 1,000 bombers is allowed to add to the price of the planes an additional sum representing the anticipated obsolescence of his facilities. This depreciation of his bomber-production equipment is naturally higher than the depreciation of tools he might use in producing civilian-type transport planes for the Government. That's because today's bomber may become obsolete in just a few years, while a transport model usually remains in operation for a decade or longer.

"True depreciation" of production equipment in negotiated military contracts has nothing to do with the accelerated tax amortization of production facilities authorized by the Office of Defense Mobilization. Purpose of the ODM "fast write-off" program is to spur investment in facilities and equipment needed to produce defense and defense-related goods. A plant operator who gets a quick write-off from ODM is permitted to deduct the cost of his new facility from his taxable income at a faster rate than that normally permitted by the Government.

Failure of the military services to get together in their allowance of depreciation of facilities in calculating contract costs has annoyed contractors. The Navy, for example, is more generous than the Air Force in permitting rapid depreciation. So a contractor turning out goods for both services may find himself in the position of having identical tools in his plant getting two different rates of "true depreciation."

To bring these divergent service policies into line, the Defense Department plans to rewrite its present directive governing the allowance of depreciation on military production facilities. Some officials feel the new version will provide more exact "guide lines" for military procurement officials so that they will all pull in the same direction in figuring depreciation in military contracts.

In addition, the Pentagon plans a second directive which will create a "superboard" to be headed by an Assistant Secretary of Defense. This board will review and coördinate the rulings of the "facilities depreciation boards" of the three services which have been grappling with the problem by themselves up to now.

Rapid depreciation has been a No. 1 headache for the Government since the outbreak of the Korean War. When the fighting started, for example, the Pentagon

MEETINGS OF NATIONAL TECHNICAL DIVISIONS AND COMMITTEES OF THE AMERICAN ORDNANCE ASSOCIATION

● **Welding Committee of the Advisory Technical and Research Group, probably at Washington, D.C., September 9, 1954.**

● **Proving Ground Instrumentation Committee of the Fire Control Instrument Division, September 1954.**

had no authority to permit defense contractors anything more than normal peacetime depreciation on their production facilities, even though the facilities they used might become obsolete in a matter of three or four years. When the Pentagon finally received authority to allow wartime depreciation in 1952, producers who had negotiated contracts in the early days of the war applied for increases on their old contracts.

At present, according to Pentagon officials, about 150 contracts are waiting for redetermination. They cover orders for aircraft, electronics items, fire-control devices, ammunition equipment, and similar goods and involve "several hundred million dollars' worth of production facilities" which are now eligible for higher depreciation allowances. Nobody knows for sure how much additional money will be required to settle these contracts, but Pentagon officials doubt that the Government will have to pick up a very large tab to handle them.

One big source of confusion for industry has been the fact that the Renegotiation Board is required by law to allow defense contractors to recover all the costs which they would be allowed to deduct in computing their taxable income. This means, in effect, that the Renegotiation Board must allow defense producers the full amount of "depreciation" permitted them in the certificates they receive from ODM.

Noting this, industrialists argued at one time that the Defense Department likewise should adopt the accelerated tax amortization allowances granted for new facilities by ODM in figuring rapid depreciation. But Pentagon officials and other Government men balked at this proposal on the ground that the fast tax write-off allowances given by ODM were far in excess of what they would consider realistic depreciation. They reasoned that adoption of the ODM allowances would substantially increase the cost of the Korean build-up to the U.S. taxpayer.

Besides the "true depreciation" used by the Pentagon and "full amortization" used by the Renegotiation Board, the Government has still another method for figuring depreciation. That is found in the regular peacetime tax amortization code of the Internal Revenue Service. This code sets the rates at which owners of factories, houses, tools, and thousands of other items are allowed to write off their investments for tax purposes.

● **News of Technical Divisions and Committees:** The National Executive Committee of our Association has recently authorized the establishment of another new A.O.A. Technical Division to be known as the *Underwater Ordnance Division*. Initially this new Division will have an Executive Board, a Torpedo Committee, and a Mine Committee.

For the time being, it is considered that any fire-control problems pertaining to this new Division can be handled by the appropriate Committee of our existing Fire Control Instrument Division. Should it be found later that this plan does not function with the maximum efficiency, then steps will be taken to organize a separate Fire Control Committee for this Division.

It is also possible that problems relating to thrown weapons, nets, detectors, and exploders may require organization of additional Committees within the new Division. This new Division is now in the process of being organized and staffed.

C. K. Davis, president of the Remington Arms Company, Bridgeport, Conn., who has been chairman of our Small Arms and Small Arms Ammunition Division since its establishment, retired from active business and at the same time requested that he be relieved as chairman of this important Division.

Mr. Davis' request was acceded to with much regret, as the Small Arms and Small Arms Ammunition Division under his leadership had been developed into one of the most active and important Technical Divisions of the American Ordnance Association. *Fred F. Hickey,* president of the Savage Arms Corporation, Utica, N.Y., long-time deputy of this Division, has become the new chairman.

Maxwell R. Warden, newly elected president and general manager of the Remington Arms Company, has become the new deputy chairman of the Division.

George F. Luckey, president of the Hamilton Watch Company, Lancaster, Pa., recently retired from active business and at the same time submitted his resignation as chairman of our A.O.A. Watch and Clock Committee of the Fire Control Instrument Division. Mr. Luckey's request was accepted with great reluctance, but we are pleased to report that *Arthur B. Sinkler,* the newly elected president of the Hamilton Watch Company, has accepted the chairmanship of this very important A.O.A. Technical Committee.

ASSOCIATION AFFAIRS

A.O.A. Holds 36th Annual Meeting at Fort Worth and Carswell AFB, Texas

The Air Force—represented principally by the Strategic Air Command and the Air Research and Development Center—the titanium industry, and the Fort Worth-Dallas area of Texas joined with the American Ordnance Association to make the Thirty-sixth Annual Meeting of the A.O.A. on May 6th and 7th a roaring success.

After a day of absorbing discussions on the research and development activities of the Air Force and the latest advances in techniques of producing and using titanium, the members gathered under balmy Texas skies to witness tests and demonstrations at Carswell Air Force Base, part of the widespread domain of the Strategic Air Command.

Many of the members arrived at headquarters in the Hotel Texas at Fort Worth the afternoon before the meeting opened officially. On May 6th Warren W. Wells, president of the Lone Star Post, greeted the members who had gathered from all parts of the country and introduced Brig. Gen. L. I. Davis, Director of Development of the Air Force's Air Research and Development Command in Baltimore.

The remainder of the morning General Davis and his principal division heads gave a clear and complete view of the research and development problems of air armament. Col. Philip S. Robbins outlined the vast ARDC organization, and Col. Robert T. Fincke and Col. Leroy L. Stefen described the desired military characteristics of air ordnance and the trends in modern fire-control systems. Col. James N. Sammons brought the audience up to date on the latest techniques of packaging and handling the vast and varied items of Air Force equipment. All these papers are published in the Armament Technology section of this issue, beginning on page 153.

Robert L. Biggers, national A.O.A. vice-president in charge of Posts, presided at the Industrial Preparedness luncheon where Maj. Gen. C. T. Harris, Jr., greeted the Industry-Ordnance Team on behalf of Texas. General Harris told of the early days of the Association and made a strong plea for the continuance of the splendid relationships carried on by industry and Ordnance through the Association.

The guest of honor, August C. Esenwein, vice-president of Consolidated Vultee Aircraft Corporation, related the achievements in the aircraft industry in furthering the air power of this Nation and made it apparent that this industry takes its responsibilities seriously. His address is published on page 37 of this issue.

After the luncheon the members assembled again in the Hall of Exhibits for the titanium seminar at which Col. B. S. Mesick, commanding officer of Watertown Arsenal, presided. Colonel Mesick had assembled an outstanding team comprised of Frank H. Vandenburgh, Thomas E. Perry, and David Goldberg to speak on the particular uses of titanium.

These talks were followed by an excellent treatise by Maj. Gen. Kern B. Metzger of the Air Matériel Command on the strategic use of titanium. (All the papers on titanium are being published in brochure form for the Company Members of the Association. The brochure will be available to individual members on request.) The audience was thoroughly engrossed in this subject and many questions followed the talk.

In addition to Watertown Arsenal, the exhibitors of titanium processes and production to whom the A.O.A. is indebted for their generous coöperation were: Boeing Airplane Company, Consolidated Vultee Aircraft Corporation, Curtiss-Wright Corporation, General Electric Company, Harvey Aluminum Company, Kropp Forge Company, Lockheed Aircraft Corporation, North American Aviation Corporation, Solar Aircraft Company, Western Gear Works.

The guest of honor at the dinner meeting held in the Crystal Ballroom of the Texas Hotel was Lieut. Gen. Emmett O'Donnell, Jr., Deputy Chief of Staff, Personnel, United States Air Force. Mr. Wells presided at the meeting, and Brig. Gen. Terence P. Finnegan, Deputy Chief of Chaplains, USAF, delivered the invocation and benediction.

The guests were welcomed to Texas by J. B. Thomas, president of the Texas Electric Service Company. The toastmaster, Lieut. Gen. Levin H. Campbell, Jr., president of the American Ordnance Association, struck the keynote of the meeting—"Aircraft armament, key to air power"—in his introduction of the guest of honor. General O'Donnell delivered a splendid address concerning the rôle of air power in the framework of the diplomatic and military affairs that together support our national policy and noted that national security depends on national unity. This address is published on page 34.

Among distinguished guests at the Fort Worth meeting were, left to right: Maj. Gen. J. B. Montgomery, commander, Eighth Air Force; J. E. Schaefer, Boeing Airplane Company; Lieut. Gen. Emmett O'Donnell, Jr., Air Force Deputy Chief of Staff; W. W. Wells, president, Lone Star Post, A.O.A.; Assistant Army Secretary G. H. Roderick.

The day at Carswell was opened at the base auditorium where Maj. Gen. John B. Montgomery, Commander of the Eighth Air Force, presented a detailed account of the history and operations of the Strategic Air Force. The members then moved along to see aircraft on the line and full-scale training exhibits that showed exactly how the equipment in an aircraft operates.

On the flight line the B-36, B-47, F-84F, F-86F, F-94, C-124, and KC-97 were displayed. Many members had a chance to explore the B-36 and peer into the working spaces of the B-47.

Shortly before the barbecue luncheon the members gathered at the picnic grounds where the air demonstration took place. Almost overhead, from 50 to 6,000 feet above the ground, B-36's, B-47's, and F-86's swooped out of the sky. Air Matériel Command exhibited the FICON operation where an F-84 is hooked onto and released from a B-36; the KC-97 flew overhead while a B-47 hooked up to its boom to refuel.

The climax of the demonstration was superb performance of precision flying—part of the training of all combat fighter pilots—by the Thunderbirds who executed perfect loops and rolls while maintaining close formation.

The afternoon was devoted to visiting Convair's B-36 plant located adjacent to Carswell. The party was greeted by Mr. Esenwein and conducted through the mile-long plant where over 200 B-36's have been manufactured and assembled under one enormous roof. At the end of the production line the members stopped to watch the waist guns of a B-36 firing at a fixed target.

The one lesson that should stand out in the minds of all members as a result of this meeting is the need for continued close coöperation between industry and the Air Force so that our armament will keep pace with aircraft development.

Florida Post Holds "Get-Acquainted" Dinner and Plans Membership Drive

The Florida Post had a special "get-acquainted dinner" at the Staff Restaurant, Fort Walton Beach, on April 12th. Col. Paul S. Bechtel, Post president, introduced Brig. Gen. Edward P. Mechling, commander, Air Force Armament Center, the Post representative on the National A.O.A. Council, who welcomed the members and guests and explained the activities and aims of the American Ordnance Association.

Maj. Robert L. Reid, Ordnance Corps, discussed the intricate problems involved in the Army's program of rebuilding its equipment in the Far East after World War II. This vast rehabilitation program was directed by Army Ordnance from headquarters in Tokyo and carried on by Japanese industrialists and workmen.

Major Reid told of the hundreds of tanks, artillery pieces, combat vehicles, and trucks that were salvaged from the jungles of the Western Pacific and sent to Japan for overhaul. Major Reid later fought in Korea where these same rebuilt vehicles saved the day for our hard-pressed troops.

With this well-attended meeting as a starting point, the Florida Post made plans for a strenuous drive to build up its membership. At the meeting, Lieut. Col. Gilbert Foster was elected second vice-president to replace Richard L. Baker, and Maj. Francis Hall was chosen to replace Anthony Casper as assistant secretary. W. G. Whitfield and Ambrose Neighbors were placed on the Membership Committee to spearhead that activity.

Maj. R. L. Reid, Ordnance Corps, addresses Florida Post meeting. Others at speakers' table, left to right, are: Dr. H. H. Bailey, Rand Corporation; Brig. Gen. E. P. Mechling, commander, Air Armament Center; Col. P. S. Bechtel, Post president.

• **AT SYRACUSE.**—The Syracuse Chapter of the Empire Post held its spring dinner meeting at the American Legion Civic Center on May 12th.

A great turnout was on hand to greet Philip P. Glassey, vice-president of Easy Washing Machine Company and a former chapter chairman, who was the guest speaker. Mr. Glassey had returned recently from six weeks in East and West Berlin and related his experiences abroad and his impressions of the battle for freedom being waged on the Iron Curtain's edge.

Col. Edward G. Miller, deputy chief of the Rochester Ordnance District and secretary of the Empire Post, reviewed the aims of the American Ordnance Association and brought the chapter members up to date on developments in the procurement field.

• **AT CHARLESTON, S. C.**—Eighty members of The Citadel Post assembled in their Alumni Hall on April 8th for a spring business meeting and to greet Capt. Brooks Harral, U.S.N., chief of staff, Mine Forces, Atlantic Fleet, the guest speaker.

Captain Harral was accompanied by Lieut. Col. R. E. McDonald, assistant professor of military science and tactics at The Citadel.

Captain Harral described how mines are swept and gave much interesting detail on the detonators used on naval mines. He recounted some of his combat experiences during World War II when on submarine combat patrols in the Pacific.

At the business meeting, plans were made for an all-out membership drive and a farewell banquet for the senior cadet members.

• **AT NEW YORK.**—The New York Post held its semiannual dinner meeting on May 10th at the Hotel Astor, New York City, with more than 300 members and guests in attendance. At the business meeting reports of the chairmen of the Program, Membership, Public Information, and Technical Committees were read and approved.

Lieut. Col. J. W. Graham, the new secretary-treasurer, was introduced to the Post, and the year's activities were reviewed by the retiring president, Vice-Adm. George F. Hussey, Jr.

A. E. Van Cleve, chairman of the Nominating Committee, reported the proposed slate of officers and directors who were thereafter unanimously elected.

By this election Maj. Gen. R. L. Maxwell, vice-president of American Machine & Foundry Company, steps up to Post president and Admiral Hussey becomes

one of the four vice-presidents. Nelson Anderson, Eastern Tool & Manufacturing Company; Arnold Erlanger, U. S. Hoffman Machinery Corporation; G. O. Kuhlke, Arma Corporation; and G. B. Welch, Mergenthaler Linotype Company, were elected to the board of directors from which George W. Allison, C. L. Farrand, and H. A. Peterson are retiring.

General Maxwell then assumed the chair as president and led a discussion on a proposed visit to West Point which was favorably received by the members present.

Before closing the business meeting, Col. Leo A. Codd, A.O.A. executive vice-president, read a memorial in honor of Vice Adm. W. H. P. Blandy, a recently deceased former vice-president of the Association and outstanding member of the New York Post. Colonel Codd then gave the audience a brief review of the events of the Thirty-sixth Annual Meeting of the Association.

Capt. J. M. P. Wright, A.O.A. staff consultant for local Posts, then presented to Admiral Hussey on behalf of the national officers and director of the A.O.A., a Certificate of Appreciation for his excellent service as president of the Post for the past four years.

After a delicious buffet dinner, the members were treated to a showing of the A.O.A. film, "Ordnance Day at Aberdeen, 1953," and a Navy film entitled, "Guided Missiles."

Yankee Post Holds Dinner Meeting, Honors Colonel Pfeil at Newton, Mass.

The third and last meeting of the 1953-1954 season was held by the Yankee Post at the Woodland Golf Club, Newton, Mass., on May 13th. This was a gala event in which the facilities of the club were made available to the A.O.A. members for luncheon and golf, and, for the more strenuous, a softball game during the afternoon.

After a delightful afternoon in the open, the members and guests assembled for a reception at 5:30 p.m., followed by a roast-beef dinner. Among the guests were many members of the New England Chapter of the Air Force Chemical Association.

Helge Holst, president of the Yankee Post, presided at the meeting and after dinner awarded the prizes to winners in the afternoon games. He then presented the Yankee Post Distinguished Service Award, a solid gold medal, to Col. John S. Pfeil, vice-president of Stone & Webster Engineering Corporation, a regional vice-president of the American Ordnance Association and chief of the Boston Ordnance District.

Colonel Pfeil was honored for the many years of outstanding service he has given as an officer in World Wars I and II and as an active participant in ordnance production and the activities of the A.O.A. Special appreciation was also expressed for Colonel Pfeil's continuing assistance to young men in their civic and corporate activities.

The subject of the third symposium meeting was, "Offshore Procurement—Participation or Competition?"

The Government program was presented by Lawrence C. Vass, Officer in Charge, North Atlantic Economic and Military Assistance Affairs, Department of State, who explained the reasons and objectives of the present overseas procurement program.

Ray C. Ellis, vice-president, Raytheon Manufacturing Company, then told how his firm is using this program both to serve our country and to extend the company's markets abroad.

Col. John S. Pfeil, right, receives Yankee Post Medal from Helge Holst, president.

WASHINGTON POST HOLDS TWO LUNCHEON MEETINGS

The Post in our Nation's Capital met on April 15th in the ballroom of the National Press Club to honor Vice Adm. John E. Gingrich, Chief of Naval Matériel. Col. Ludlow King of Universal Products and president of the Post presided at the speakers' table and introduced the following distinguished guests:

Maj. Gen. William D. Eckert, Assistant Deputy Chief of Staff, Matériel; Brig. Gen. J. H. Hinrichs, Assistant Chief of Ordnance, and Chief of Ordnance Field Service; Comdr. M. V. Fowler, aide to Admiral Gingrich; Maj. Gen. Gilman C. Mudgett, Chief of Information, United States Army; Brig. Gen. Earl S. Gruver, Deputy Chief of Army Ordnance; Col. Bernt Balchen, U. S. Air Force, noted pilot, explorer, author, and a pioneer in the development of U. S. Air Force bases in the Arctic.

Admiral Gingrich gave an impromptu talk on "Economy and Military Logistics." He told the assembly that economies had been effected by the Navy during the Korean campaign through sensible utilization of ammunition and by reducing unnecessary high-speed operations. Some of the savings the Admiral listed were startling. He also pointed to numerous means the Navy had employed ashore to obtain the most out of the severely budgeted dollar.

On May 20th the Post closed its most active season with a luncheon meeting at the Press Club where new officers and directors were elected for the 1954-1955 season.

In his last meeting as presiding officer, Colonel King, Post president, introduced the following distinguished guests:

George H. Roderick, Assistant Secretary of the Army (Financial Management); Rear Adm. Louis S. Parks, Chief of Information, U. S. Navy; Lieut. Gen. John K. Christmas, U.S.A., Ret., Barium Steel Corporation; Col. B. R. Olmstead, U.S.A., Ret.; and Carl F. Pilger, acting chief, Special Weapons Systems, Office, Chief of Ordnance.

Colonel King then called upon Col. Leo A. Codd, executive vice-president of the national Association, who spoke in behalf

of General Campbell to congratulate "Pete" King on his splendid leadership in the Washington Post over the past two years.

Dr. A. V. Astin, Director, National Bureau of Standards, was next called upon to present the choice of the nominating committee for new officers and directors. The members voted unanimously to accept the nominees who were:

President—George M. Riveire, Goodyear Tire & Rubber Company, Washington, D. C.

First Vice-President—Karl J. Ammerman, Borg-Warner Corporation, Washington, D. C.

Second Vice-President—Franklin B. Reybold, Willys Motors, Inc., Washington, D. C.

Representative of the National Council, A.O.A.—Colonel King, Universal Moulded Products Corporation, Washington, D. C.

W. D. Kavanaugh, American Cyanamid Company; Maj. Gen. William T. Eckert, U.S.A.F.; and T. J. McCloskey, Navy Bureau of Ordnance, were elected to the Post's board of directors.

Brigadier Richard H. Barry, C.B.E., of the British Army, now Director of the Standing Group, NATO, as guest speaker gave a concise and interesting talk on the formation, organization, and progress of NATO. He explained that Russian pressure caused the creation of the Western Union of the "Benelux" countries from which the North Atlantic Treaty Organization was developed in order to add the needed power of the United States. The political and military division of authority in NATO was clearly drawn.

Brigadier Barry pointed to the major achievements of NATO in its five years of existence—a fourfold increase in ground divisions and air forces, a mutual knowledge of the military plans of the member nations, and, most highly praised, a tremendous growth of mutual understanding and acquaintanceship among officers of the allied nations.

Puget Sound Post Celebrates Industry-Ordnance Day at Mt. Rainier Depot

Industry-Ordnance Day in the Northwest was celebrated at the Mt. Rainier Ordnance Depot, Fort Lewis, Wash., in a joint meeting of the Puget Sound Post of the American Ordnance Association and the Seattle and Tacoma Chambers of Commerce. Many members from the Columbia River Post of the A.O.A. joined the celebration. More than 570 members and guests registered during the forenoon and made an inspection tour of the depot.

In the maintenance building they were briefed on the purpose and capacity of the facility and were shown a model exhibit of a German V-2, a Hermes, a Nike missile, and an exhibit of various duds and bombs recovered by the 552nd Ordnance Explosive Disposal Squad. The production lines were open to visitors, and a T108 self-propelled 8-inch howitzer, manufactured by the Pacific Car and Foundry Company of Renton, Wash., was on display.

Lunch was served at the Sixth Army Cooks' and Bakers' School after which the members proceeded to the Fort Lewis Reservation to witness demonstrations of firepower. In a period of two hours the numerous individual hand weapons of an infantry division were exhibited and fired followed by a mock infantry attack with supporting weapons including low-flying jets dropping 500-pound bombs, rockets, and napalm bombs in advance of the attack.

Over 400 persons remained to attend the dinner where Maj. Gen. Emerson L. Cummings, Chief of Army Ordnance, was guest of honor and principal speaker. C. Walter Huffine, president of the Post, presided and called upon the Very Rev. A. A. LeMieux, president of Seattle University, to give the invocation.

Paul Pigott, president, Pacific Car and Foundry Company as toastmaster of the evening introduced General Cummings who described the recent additions to the Army's arsenal such as the Corporal missile and the T43 tank, reviewed the mission and broad objectives of Army Ordnance, and told what Army Ordnance was doing to carry out its mission.

Attending Puget Sound Post meeting were, left to right: A. H. Hooker, president, Hooker Chemical Corporation; Walter Huffine, Post president; Col. F. G. Crabb, Jr., commanding Mt. Rainier Ordnance Depot; and F. B. Lee, Post secretary-treasurer.

QUAD CITIES-IOWA POST MEETS AT ROCK ISLAND

On April 23, 1954, the Quad Cities-Iowa Post engaged in a heavy schedule of events.

At noon the board of directors met at a luncheon at the Rock Island Arsenal Golf Club and voted to restudy the membership distribution in their area, to increase activity in outlying cities such as Des Moines and Cedar Rapids, and to approach the Research and Development Branch of Army Staff Headquarters for speakers for the ensuing year.

After the luncheon the directors joined a large group of members and guests on a tour of the arsenal.

The film "Ordnance Day at Aberdeen, 1953" was shown in the late afternoon prior to a social hour in the arsenal post dining room. This was followed by a dinner meeting called to order by Philip S. Mumford, post president, who spoke briefly on the plans of the board of directors and the aims and purposes of the A.O.A., and then introduced Col. T. A. Weyher, commanding officer of Rock Island Arsenal and formerly chief of the Research and Materials Branch, Office of the Chief of Ordnance.

Colonel Weyher spoke on the subject, "Operation PEQUO," stating that Rock Island Arsenal had been designated in February 1954 as the headquarters responsible for all records and administration of production machinery for the Army.

He indicated that quantities of material on hand are sufficient to meet initial requirements but that the application of this material to actual production is a problem that engaged the best minds in the Ordnance Department and the American Ordnance Association.

T. E. Stahl of the Bomb Committee and F. O. Gilbert of the Surface Preservation Committee made brief reports on their respective groups.

At the conclusion of the meeting Mr. Mumford congratulated the members on their good attendance and thanked Colonel Weyher for his talk on the new local activity.

Capital Cities Post Elects Officers, Holds Career Clinic for Students

The principal item of business at the meeting of the board of directors of the Capital Cities Post at Schenectady, N.Y., on April 22nd was the election of officers for 1954-1955. It was decided that the next president should be other than a Schenectady man, and Earl D. Rhodes, general superintendent, Kenwood Mills, was chosen for this office. Col. R. Z. Crane will continue as first vice-president, William C. Elcan was elected second vice-president, and Paul F. Biglow will become secretary-treasurer.

The new Post directors are: Edward Doherty, National City Bank, and Vincent D'Anza, Attorney General's staff.

Reports were received from the secretary-treasurer, the Industrial Preparedness Committee, Public Information Committee, the Program Committee, and the Committee in charge of Student Activities.

O. R. Schurig, chairman of the Membership Committee, presented a thorough analysis of the problem of increasing membership in the Schenectady area where he believed all profitable sources had been solicited and a broadening of activities would be required for further enlargement of the membership.

On April 29th, under the sponsorship of the Capital Cities Post, the Annual Career Clinic for high-school students of the area was held in the Troy High School building. The objective of this committee of industrialists and high-school educators is to instruct high-school students, who do not plan a college career, in the opportunities, necessary training, and tasks to be performed by qualified technicians.

The afternoon was occupied in discussion of the problems raised by the representative high-school students who were present. This worth-while civic effort could well be emulated by other Posts of the American Ordnance Association.

Participating in Capital Cities Post Career Clinic were, seated left to right: G. F. Maedel, James Allgeier, Ray Stearns, Otto Guenther, Dr. Leo Smith. Standing, left to right: F. J. Coyle, R. G. Stevens, G. B. Wagner, John Shirley, G. Schlear, and Joseph Degen. The clinic advises high-school students about technical training.

Vice Adm. J. J. Clark Addresses Texas Post at Ellington Air Force Base

The Texas Post enjoyed a large turnout for its annual meeting on April 15th. Over 115 members gathered at Ellington Air Force Base to welcome Vice Adm. J. J. Clark, the guest of honor and principal speaker.

Prior to the dinner meeting a small group of early birds were treated to a tour of the base under the able guidance of Col. George O. Bond, deputy commander. They saw the training and maintenance activities under way at the base and inspected a new Convair observer training aircraft. This ship was equipped with a large quantity of electronic gear, radarscopes, and navigating equipment so that groups of eight to sixteen observers and navigators could be trained on one flight.

W. O. Hedrick, Post president, presided and introduced the following new officers and directors for the coming season: W. H. Miner, president; K. P. Campbell, vice-president; and A. D. Blackledge, N. E. Hull, and W. O. Hedrick, directors.

Maj. R. D. Stinger introduced Col. Frederick G. Bryan, deputy chief of the St. Louis Ordnance District, who stated he regretted to announce the closing of the Regional Office of the St. Louis District in Houston, and thanked all the industrialists of the Houston area for their splendid coöperation. Capt. J. M. P. Wright from A.O.A. headquarters spoke briefly of the aims of the Association and described in detail the events scheduled for the national Annual Meeting in Fort Worth on May 6th and 7th.

The guest of honor, Admiral Clark, in an informal talk reviewed the highlights of the early part of the Korean war and recounted some of his experiences while he was commander of the Seventh Fleet. The admiral considered the holding action a great mistake. He pointed out that the military cannot maintain good morale unless they are fighting for victory. He also told of encounters with Communist MIG's by naval aircraft from his task force, described the night-fighter operations that stopped sporadic night bombing of Inchon and the destruction of the power plants in North Korea.

The final event was the showing of the film "Ordnance Day at Aberdeen, 1953."

At the speakers' table, in addition to those previously mentioned were: D. J. Martin, "Admiral" Court Norton, Col. G. O. Bond, M. I. Kearn, B. T. McNeil, and Philip P. Krumb, Sr.

• **AT HEMPSTEAD.**—Lieut. Col. Lloyd Ramsey, Ordnance Corps, and a member of the A.O.A., has been named senior instructor of military science and tactics at Hofstra College, Hempstead, L. I., replacing Lieut. Col. Orville Knight who has been transferred to Rock Island Arsenal, Ill.

A veteran of World War II and the Korean campaign, Colonel Ramsey holds the Bronze Star Medal with two oak-leaf clusters.

After the war he served in Ordnance arsenals and was later assigned to the Bethlehem Steel Company. In October 1951 he was reassigned overseas and served in Korea with the 40th Infantry Division, transferring later to Japan as chief of the Engineering and Inspection Division of the Tokyo Ordnance Depot.

Colonel Ramsey's new duty places him with the largest Ordnance R.O.T.C. unit in the Reserve program.

• **ALFRED C. CASTLE,** national vice-president of the Navy League of the United States and a charter life member of the American Ordnance Association, was presented the Navy's Distinguished Public Service Award by Secretary of the Navy Robert B. Anderson during a luncheon session of the Navy League on Wednesday, April 14th, at the U.S. Naval Academy, Annapolis, Md.

Mr. Castle, retired president of A. M. Castle & Company, Chicago, now living at Pebble Beach, Calif., received the Navy's highest civilian award for "his

inspired leadership of Navy League Councils on the West Coast" and his "outstanding contributions to the Navy in the fields of morale, recruiting, education, and public information."

• **AT ABERDEEN.**—Maj. Gen. J. L. Holman, commanding general, Aberdeen Proving Ground, presented to Maj. Roy A. Hoffman the Alden Essay Award at a colorful ceremony during the graduation exercises of the Ordnance School at Aberdeen on May 11th.

The Alden Scholarship Essay Award of $100 was established by the American Ordnance Association to commemorate the devoted service of Col. H. W. Alden, a distinguished Ordnance officer in World War I and later president of Timken-Detroit Axle Company.

A contest is held annually, open to all students enrolled in courses in Ordnance Schools at Aberdeen, Atlanta, Ga., and Huntsville, Ala., to determine the winner.

• **MAJ. GEN. OLIVER P. ECHOLS,** U.S.A.F., Retired, chairman of the board and chief executive of the Northrop Aircraft Corporation, died recently in St. John's Hospital, Santa Monica, Calif., after a brief illness.

General Echols became head of Northrop on February 1, 1949, after serving for two years as president of the Aircraft Industries Association, Washington, D.C. He retired with the rank of major general in December 1946 after a career that spanned more than thirty years and two World Wars.

In World War I General Echols was a command pilot with the American Expeditionary Forces. In World War II he served as commanding general of the Air Matériel Command from March 1942 to March 1943 when he was appointed Assistant Chief of Air Staff in charge of Matériel, Maintenance, and Distribution.

In April 1945 he was chief of the Internal Affairs Division, Supreme Headquarters, and later was deputy commanding general, Office of Military Government for Germany.

From March 1945 until his retirement he was director of the War Department's Civil Affairs Division.

• **SAMUEL FLOYD KEENER** internationally known industrial engineer and amateur pilot, died in Salem, Ohio, on April 2nd. He was the retired president of Keener Industries, which grew from the Salem Engineering Company he founded in 1934.

Mr. Keener began his career as a range rider in the West in 1902, and engaged in surveying and engineering for various beet-sugar industries, 1910. He later performed general engineering for Differential Steel Car Company, Findlay, Ohio, and was with the engineering department, City of Toledo. He was also employed by Foote Brothers Gear & Machine Company, Chicago, and the Electric Furnace Company, Salem, Ohio, 1929.

He founded the Salem Engineering Company in Salem, Ohio, in 1934, serving as its president, from 1934 to 1951. He also founded Salem Engineering Ltd., Canada, 1934, and the Salem Engineering Company, Ltd., Milford, England, 1936.

He was a life member of the American Ordnance Association and a member of numerous other societies.

In World War II "Sam" Keener and his Salem Engineering Company supplied and erected most of the annealing furnaces in the many small-arms ammunition plants located in the West. He backed the war effort of Army Ordnance to the hilt and was well-known to all the small-arms industrial ordnance personnel in Washington and in the field.

He was a colorful personage and will be missed by his many friends in the A.O.A. and in industry.

• **PIERRE S. DU PONT,** a life member of the American Ordnance Association and former president of E. I. du Pont de Nemours & Co., died at Wilmington, Del., on April 5, 1954—the oldest living member of the family which, since 1802, has been so closely identified with ordnance progress in the United States.

Mr. du Pont helped in the development of two of America's biggest industrial organizations—the Du Pont Company and General Motors Corporation, both of which he had served as president.

He became president of Du Pont in 1915, and under his leadership the company in four years of World War I was a major support of the Allied cause, having produced a billion and a half pounds of powder and explosives, including more than forty per cent of the smokeless powder used by the Allies.

Following his relinquishment of the presidency of the company in 1919 he was chairman of the board until 1940 and honorary chairman since that time. He was elected president of General Motors Corporation in 1920 and served for three years.

An intimate friend of several of the founders of the American Ordnance Association—Maj. Gen. William Crozier, Maj. Gen. C. C. Williams, and Brig. Gen. Benedict Crowell—Mr. du Pont was an ardent advocate of industrial preparedness.

He saw at first hand the tremendous need for an informed industry at the time of our entry into the First World War and urged the establishment of an organization which would keep industry alerted to the armament problems of our national defense.

His contributions to our defense structure in the nature of research, development, and production engineering, especially as they relate to powder and explosives, were intimate and constant.

He reflected the long tradition of his ancestors who, since the foundation of his company in 1802, have provided major industrial support for the armed forces of the United States.

• **ARTHUR PRESTON PAINE,** associate director of research for Mergenthaler Linotype Company and for many years head of Linotype patent activities, died at his home, Brooklyn, N.Y., on March 25, 1954.

Mr. Paine was appointed director of patents for Linotype in 1929, subsequently becoming associate director of research in 1946. From 1937 to 1946 he was president of the Linotone Corporation, a subsidiary of Mergenthaler Linotype Company.

In 1917 he was commissioned a second lieutenant in the Ordnance Department of the Army and was called to duty at Sandy Hook Proving Ground, after which he served successively at Aberdeen Proving Ground and the Savanna Proving Ground prior to his discharge in the rank of captain on April 10, 1919.

Immediately after World War I, Mr. Paine joined the Winchester Repeating Arms Company as its patent engineer and held that position through 1921 when he was engaged by the Crompton and Knowles Loom Works as the chairman of its technical committee and remained until he rejoined Mergenthaler Linotype as director of patents in 1929.

Mr. Paine was a charter member and honorary life member of the American Ordnance Association, a member of Delta Kappa Epsilon Fraternity, a member of the Grand Jury Association of New York County, the Amherst Club of New York, the American Society of Mechanical Engineers, and the American Radio Relay League.

• **ALBERT A. HOFFMAN,** internationally known mining engineer, died in Providence Hospital, Oakland, Calif., on May 4th, after a long illness. At the time of his death he was vice-president and a member of the board of directors of Calaveras Cement Company, San Francisco. He joined the firm in 1944 as consulting engineer.

Born in Parsons, Kans., on July 28, 1880, Mr. Hoffman studied mining engineering at the University of Kansas and then became associated in managerial positions with copper mining enterprises in Chile. He was a captain in Army Ordnance in World War I.

From 1936 to 1941 Mr. Hoffman was

California manager of the American Potash and Chemical Corporation and president of the Trona Railway Company. He was general manager of the Nicaro Nickel Company of New York and Cuba in 1942 and 1943, leaving that position to manage the Las Vegas, Nev., plant of Manganese Ore Company until 1944.

Mr. Hoffman was a member of the American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers, and the American Ordnance Association.

• **JOHN A. ZELLERS,** died at his home in New York City, April 30, 1954. Until his retirement he had served as a vice-president of Remington Rand Inc. and was known as "the dean of the American typewriter industry." He served on the Endowment Committee of the American Ordnance Association and was one of its most loyal and energetic supporters.

Mr. Zellers was born in Lebanon, Pa., and after attending William Jewell College he enters the typewriter industry in Kansas City, Mo. Later he joined the Remington organization, serving in many assignments of responsibility including manager of European affairs and general foreign director.

During the Second World War he was chairman of the industry group for the War Labor Board in New York and New Jersey. He also directed the operations of the Remington Rand organization in the field of defense equipment and specialized in ordnance operations.

He was an energetic advocate of the ordnance preparedness and took an active part in the New York meetings of the Association and of the New York Post which he served as a director for several terms.

His counsel and advice were of great help to the headquarters staff of the Association at Washington by whom he will be especially missed.

• **CHARLES B. HANSON,** assistant of the president of Cobusco Steel Products, Denver, Colo., and a member of the Association's Shell Committee, died at his home in Denver on April 22nd. He was a member of the American Ordnance Association and a frequent attendant at its national and regional meetings.

A close business associate of James D. Maitland, president of the company and president of the Association's Rocky Mountain Post, Mr. Hanson was a leader in the steel products industry of the West. He took an important part in the production of artillery shell for the Ordnance program during the Second World War and the Korean war, enabling his company to attain an outstanding record in this important field. He was also an active participant in many civic enterprises in Colorado where his wide circle of friends included many of the members of the Rocky Mountain Post of which he was an active member.

• **BRIG. GEN. EDWARD W. SMITH,** Ordnance Officer of the Seventh Army in the Second World War and a member of the American Ordnance Association from its early days, died at Walter Reed Hospital, Washington, on May 19, 1954. He was retired in 1946.

General Smith was a native of Livingston, Ala. He was graduated from the United States Military Academy at West Point, a member of the class of 1918. One of his first duty assignments was as an instructor at the Academy.

He also served in Panama and in various Ordnance assignments throughout the United States, including four years in the Office of the Chief of Ordnance, Washington, from 1934 to 1938.

In April 1943 he became Ordnance Officer of the IV Corps and went with it overseas in the following year. He then became Ordnance Officer of the Seventh Army, participating in its campaigns and victories in Europe.

General Smith will be remembered by members of the Ordnance fraternity for his many contributions to Ordnance progress, particularly in the field-service phases of military supply. At the time of his death, he was an active member of the Association's Washington Post.

ORDNANCE R.O.T.C. MEDALISTS

The honor cadet in each of the Ordnance R.O.T.C. Units in colleges throughout the country was awarded the American Ordnance Association Scholarship Key for the year 1954 and a year's membership in the Association at presentation ceremonies throughout the country. Awards were made at the following colleges and universities:

University of California.—Cadet John C. Rosser, Jr., Oakland, Calif., majored in engineering physics and was battalion commander in the R.O.T.C. regiment. He intends to accept a commission in the Regular Army Ordnance Corps this October.

University of Cincinnati.—Cadet David S. Reynolds, Cincinnati, Ohio, specialized in mechanical engineering and was the distinguished military student of his R.O.T.C. unit.

The Citadel.—Cadet First Sgt. H. H. Moorer, Charleston, S.C., expects to continue graduate work in chemistry, his major field. He has been a strong supporter of The Citadel Post of the American Ordnance Association as well as being the outstanding cadet in ordnance.

Clemson Agricultural College.—Cadet Lieut. Col. Jerry E. Dempsey, Anderson, S.C., graduated as the number one student in the School of Engineering and was a distinguished military student.

Colorado A. & M. College.—Cadet Ronald W. Drager, LaPorte, Colo., majored in mechanical engineering and is to be commissioned as second lieutenant in the Ordnance Corps Reserve upon graduation.

Cornell University.—Cadet Col. Alan Q. Eschenroeder, Webster Groves, Mo., was the outstanding junior of his class in 1952-1953, and graduated first this year in the College of Mechanical Engineering. He was also the outstanding Ordnance senior.

Dartmouth College.—Cadet Maj. George B. Passano, New York City, a fifth-year student in the Engineering College, will receive his master's degree in June. He is a cadet major in the Ordnance R.O.T.C. unit and was selected as a distinguished military science student by the college authorities.

Georgia Institute of Technology.—Cadet Robert M. Sharp, Atlanta, Ga., majored in chemistry. He was a top honor student and Regimental S-4 of the corps.

J. C. Rosser, Jr. D. S. Reynolds H. H. Moorer J. E. Dempsey

F. W. Mollerus, Jr. R. W. Drager R. M. Sharp Gregory Rudolph E. E. Jung A. Q. Eschenroeder

Gonzaga University.—Cadet Fred W. Mollerus, Jr., Hanford, Wash., was graduated *magna cum laude* in mechanical engineering and has been accepted for a commission in the Regular Army.

Hofstra College.—Cadet Maj. Edward E. Jung, Hicksville, N.Y., majored in business administration and has been an honor student through his four years of college. Cadet Jung is executive officer of the 3rd Battalion of the cadet corps.

University of Illinois.—Cadet Gregory Rudolph, La Crosse, Wis., is an honor student in electrical engineering who hopes to specialize in guided-missile work after graduation.

J. A. Harper, Jr. P. R. Hopper

Lafayette College.—Cadet Lieut. Col. Donald S. Smalley, Monmouth, N. J., is an honor student in chemical engineering and commander of the Ordnance Drill Battalion of the Lafayette Cadet Corps. He will be commissioned in the Ordnance Corps Reserve upon graduation.

Lehigh University.—Cadet J. Allen Harper, Jr., Philadelphia, Pa., is specializing in industrial engineering. He has been a member of the rifle team and attained the rank of cadet major in the Army R.O.T.C. Unit and was assigned as Regimental S-3 in the Lehigh Corps of Cadets.

Marshall College.—Cadet Capt. Paul R. Hopper, Wayland, Ky., is a junior and is majoring in accounting.

Massachusetts Institute of Technology.—Cadet Lieut. Col. Ernest P. Abrahamson, Boston, Mass., majored in metallurgy and after receiving his commission in the Ordnance Reserve Corps will begin graduate work for a master's degree at M.I.T.

University of Minnesota.—Cadet Vernon F. Minnis, St. Paul, Minn., is a junior in the Institute of Technology and a distinguished military student.

University of Nebraska.—Cadet Master Sgt. Donald D. Nuss, Arlington, Va., is a student in fine arts and sciences and the outstanding Ordnance cadet.

North Carolina State College of Agriculture and Engineering.—Cadet Maj. Robert B. Jordan, Mt. Gilead, N.C., specialized in industrial lumber. He was the executive officer, 1st Battalion, of the Cadet R.O.T.C. Regiment and was designated as the distinguished military graduate.

Purdue University.—Cadet Eugene J. Axnix, Jr., South Bend, Ind., honor student in industrial education, was president of the Purdue Ordnance Club. He was awarded the Cincinnati Post Ordnance Scholarship Key in 1953.

Rutgers University.—Cadet Lieut. Col. Richard E. Miller, Temple, Pa., majored in forestry. He plans to begin active duty in the Ordnance Corps in May 1955.

Seattle University.—Cadet Capt. J. Richard Manning, Seattle, Wash., is completing a prelaw course. He was the outstanding cadet in the fields relating to ordnance.

Agricultural and Mechanical College of Texas.—Cadet Lieut. Col. Jack W. Garrett, Del Rio, Tex. received a B.S. degree in mechanical engineering and was commissioned in the U.S. Army Reserve May 21, 1954. Cadet Garrett was president of the Student Council and a distinguished student.

D. D. Nuss E. P. Abrahamson

Utah State Agricultural College.—Cadet Frank W. Dallon, Sacramento, Calif., was graduated with a B.S. degree in tool engineering and was a distinguished military student.

Virginia Polytechnic Institute.—Cadet First Sgt. Chester D. Trivette, Jr., Kinsport, Tenn., graduated with honors and a degree in chemical engineering.

E. J. Axnix, Jr. J. W. Garrett F. W. Dallon J. R. Manning R. B. Jordan R. E. Miller

WHICH OF YOUR METAL-CLEANING JOBS WOULD YOU LIKE TO IMPROVE?

¶ Are you cleaning metal in the most economical way? *See page 9 of Oakite's* FREE *booklet on Metal Cleaning.*

¶ Are you cleaning metal the fastest way? *See page 11.*

¶ Can you clean brass anodically with no tarnish? *See page 18.*

¶ Can you clean steel and prepare it for painting for less than 20 cents per 1,000 square feet? *See page 24.*

¶ Do you need a cleaner that removes rust and oil at the same time; often eliminating all need for pickling? *See page 28.*

¶ How do you clean parts that are too large to be soaked in tanks or sprayed in machines? *See page 30.*

¶ Does your burnishing barrel produce high luster? *See page 32.*

¶ What do you do when oversprayed paint neither floats nor sinks in your paint spray booth wash water? *See page 35.*

¶ Would you like to eliminate expensive drying from your anti-rust procedure? *See page 37.*

LISTED BELOW are some of the operations discussed in this 44-page illustrated booklet. Please check the jobs in which you are interested. Then let us show you how Oakite methods can give you better production with greater economy.

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS • METHODS • SERVICE

OAKITE PRODUCTS, INC., 14F Rector Street, New York 6, N. Y.

Tell me about Oakite methods and materials for the following jobs:

- ☐ Tank cleaning
- ☐ Machine cleaning
- ☐ Electrocleaning steel
- ☐ Electrocleaning non-ferrous metals
- ☐ Pickling, deoxidizing, bright dipping
- ☐ Pre-paint treatment
- ☐ Zinc phosphate coating
- ☐ Paint stripping
- ☐ Steam-detergent cleaning
- ☐ Barrel cleaning
- ☐ Burnishing
- ☐ Rust prevention
- ☐ Treating water in paint spray booths
- ☐ Machining and grinding
- ☐ ALSO send me a FREE copy of your booklet "*Some good things to know about Metal Cleaning*"

*Name*_____

*Company*_____

*Address*_____

Technical Service Representatives in Principal Cities of U. S. and Canada

AETNA-STANDARD
has manufacturing facilities and an engineering unit specifically assigned to Ordnance work. In connection with the Skysweeper, Aetna designed and built the pilot models for the On-Carriage Fire Control. We are now building these carriages; assembling the Fire Control; and, testing by actually tracking planes. U. S. Ordnance and Aetna-Standard have worked hand in hand for many years.
DESIGNER AND MANUFACTURER OF ORDNANCE EQUIPMENT
The Aetna-Standard Engineering Company
FRICK BUILDING
PITTSBURGH, PENNA.

MATERIALS PROGRESS

George S. Brady

RATED for high honors in research development is a new electromechanical method of drilling and polishing hard carbides and steels that can do away with the use of industrial diamonds for such purposes and thus conserve this scarce and expensive strategic material. About 60 per cent of the use of industrial diamonds is in the grinding and polishing of tools.

In the new process, a brass rod of any shape (square holes can be drilled) is simply pushed through the hard carbide or, in the case of surface finishing, is merely passed along the surface. Internal contours can be cut, and curved slots in hard high-alloy turbine blades, not possible to machine by any other known method, have been cut accurately with a single pass.

The brass rod is the negative electrode, and the workpiece, submerged in kerosene or other dielectric liquid, becomes the positive electrode. Voltages up to 400 are used, but the voltage determines the gap between the electrodes, and hence the accuracy of the hole is determined by the voltage.

So far it has been possible to predict an accuracy of 0.0001-inch in the size of the hole or in the finish of a flat surface. Removing the metal by ionization produces a better finish than can be done by diamond cutting, since the diamond digs deeper into the bond of the carbide and produces microscopic ridges.

Control of the voltage is simple, and the accuracy has been limited by the accuracy of the mechanical support rather than by any difficulty in regulating the voltage.

A current density of 100,000,000 amperes per square inch is employed, and a very rapid breaking of the current is obtained by a rotating mechanical breaker. As the brass tool advances toward and into the work, tiny ionized particles of metal are detached and move toward the brass tool, but at the break of the current they are expelled from the ionized area and reform into a spherical powder which is carried away by the dielectric liquid which covers the workpiece. There is no "scrap" from this type of machining, since the carbide or metal-alloy powder is salvaged from the liquid and can be used for making other parts by powder metallurgy.

There is a critical current density for each type of alloy metal, but an excess above the amount does not produce degradation of the metal since it is absorbed by a damping circuit and thus no regulation of current is needed.

Developed by *Firth Sterling* especially to replace industrial diamonds in the finishing of carbide tools, the process is being commercialized by the *Method X Company*, Pittsburgh, Pa.

Synthetic Bristles.—Chinese hog bristles have been rated as a strategic stockpile material because of their ability to do certain types of painting that no other paint-brush fiber has been able to do.

Since the supply has been reduced drastically by the embargo against Red China, brushes with various types of synthetic fibers, including nylon, acetate, and polyvinyl chloride, have been substituted successfully for many classes of painting work, but the new Keron bristle of the *Rubberset Company*, Salisbury, Md., is the first successful attempt to make a true bristle synthetically.

The new bristles, now in pilot-plant production, and already made into brushes, are extruded from protein extracted from chicken feathers. As chickens are now dressed in great quantities in the producing areas, there is an abundant supply of feathers. The complex nonedible and water-insoluble protein of

1. "Telvar" W has extra-long residual action. Track on right was treated in April; photograph was taken in August. Ideal for sidings, around loading docks, etc.

2. Note the thorough weed control under and around this security fence and power substation.

3. Fire hazards are reduced around oil storages and pipelines from thorough, long-term weed control with "Telvar" W.

Kill weeds with Du Pont "Telvar" W *Weed Killer* —long residual action lasts all season

HERE'S a new, low-cost way to solve your weed control problems. Just one application of "Telvar" W can get rid of unwanted vegetation for a full growing season or longer. This powerful weed killer works through the roots . . . and remains in the ground to prevent regrowth. "Telvar" W keeps storage and working areas clear, neat and accessible . . . kills vegetation that may cause a fire hazard or a cover for vermin.

SAVES MONEY, TIME AND WORK . . . One spray usually does the job . . . repeat applications are seldom necessary. No bulky chemicals to handle or store. Just 1 to 1½ pounds per 1000 square feet (40 to 60 pounds per acre) will do the job.

EASY TO USE . . . "Telvar" W is a wettable powder, ready to mix with water; can be applied by machine equipment or ordinary knapsack sprayer. It doesn't corrode metals, is non-flammable, has unusually low toxicity and it is non-volatile.

IF YOU DON'T HAVE EQUIPMENT to apply "Telvar" W, a custom sprayer will do the job for you. In fact, you may want to take advantage of his year-round service.

On all chemicals always follow directions for application. Where warning or caution statements on the use of the product are given, read them carefully.

MAIL THIS COUPON FOR FREE BOOKLET

E. I. du Pont de Nemours & Co. (Inc.)
Grasselli Chemicals Department, Rm. 4026
Wilmington, Delaware

☐ Please send me your booklet describing low-cost weed control with "Telvar" W. ☐ Send me the name of my nearest supplier. ☐ Give me the name of a near-by custom sprayer.

Name_____

Firm_____

Position_____

Address_____

City_____

DU PONT TELVAR W
REG. U.S. PAT. OFF. TRADE-MARK

weed killer for low-cost weed control

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

GOVERNMENT FINISH SPECIFICATIONS

and the Parker Products which meet them

This list contains specifications most frequently called for, and some of the Parker Products which meet them. There are Parker Products to meet almost every one of the less frequently used government specifications also. A letter or telephone call to Parker, Detroit, will secure specific information on products to meet government specifications not listed here.

SPECIFICATION	PARKER PRODUCTS
JAN-C-490 (Replaces AXS-1245)	
Grade I	Bonderite 100, 160, 170, 180
Grade II	
Type 2	Parco Cleaners 341, 350, 371
Type 4	Parco Cleaners 250, 260
Type 5	Parco Cleaners 210, 220
Type 6	Parco Cleaners 100, 101, 110
MIL-10578 (Formerly U.S.A. 3-213)	
Type I (Wash-off)	Parco Cleaner 250
Type II (Wipe-off)	Parco Cleaner 260
MIL-C-5541 (Formerly AN-C-170)	Bonderite 710 (chemical film for aluminum and its alloys)
MIL-C-12968 (ORD) (Supersedes in part U.S.A 57-0-2)	
Type A—(Formerly U.S.A. 57-0-2, Type I, Class A & A1)	Parco Powder, Parco Lubrite 1 & 2
Type B	
Class 1 (Formerly U. S. A. 57-0-2, Type II, Class B)	Parco Compound
Class 2	Parco Compound plus Endurion
MIL-C-16232 (BuORD)	
Type I	Parco Lubrite 1 & 2
Type II	Parco Compound
PA-PD-191	
Grade I	Bonderite 32, 34, 100, 160, 170, 180
Grade II	
Type 2	Parco Cleaners 341, 350, 371
Type 4	Parco Cleaners 250, 260
Type 5	Parco Cleaners 210, 220
Type 6	Parco Cleaners 100, 101, 110
U.S.A. 72-53	Bonderite 32, 34, 100, 160, 170, 180
U.S.A. 57-0-2 [See also MIL-C-12968 (ORD)]	
Type II	
Class A & A1	Parco Lubrite 1 & 2
Class B	Parco Powder—Parco Compound
Class C	Bonderite 100, 160, 170 180

For information regarding these or other specifications, write

PARKER
RUST PROOF COMPANY
2165 E. Milwaukee Ave., Detroit 11, Mich.

FIRST IN THE FIELD SINCE 1915

feathers is nearly identical in chemical composition to hog bristles, and thus the fiber made from it has about the same resistance to solvents and the same paint-holding ability as the natural bristles.

With present methods of hardening the protein fiber with formaldehyde, the resulting synthetic bristle is somewhat more brittle than the natural product but has ample strength for paint brushes. For use in paint brushes, the fiber is tapered, but it lacks the scaly surface of the hog bristle.

Plastic Hearing Aid.—A new compact and lightweight hearing aid of the *Zenith Radio Corporation*, Chicago, Ill., is an outstanding example of modern plastic design. To save space and give longer battery life, three tiny transistors are used instead of vacuum tubes, and these are encased in a cast epoxy resin.

The chassis is of nylon with an acetate cover plate and a vinyl-backed printed battery circuit. The transistor sockets are molded of a phenolic resin, the spacer block is styrene, and the phone magnet cover is an acrylic resin.

The ear mold and the earphone housing are of acrylic resin, as are also the control knobs. The control bases are phenolic moldings. The earphone cord is of vinyl resin with butyrate plugs. The unit has withstood long tests at 105 degrees Fahrenheit, rough handling and dropping, and submersion in water.

Strong Plastic Rods.—A new offering in plastics is rod that has tensile and flexural strengths equal to low-carbon steel but weighs only one-fifth as much as steel. The rod has uniform color all the way through, and it machines smoothly without appearance of the fiber filler. The material is a glass-fiber-reënforced polyester containing about fifty per cent resin. Flexural strength runs as high as 85,000 pounds per square inch. The rod, in a choice of a dozen colors, comes in diameters to ½-inch and in lengths to 84 inches. It can be used for many types of mechanical parts, and its good dielectric strength recommends it also for the production of electrical parts.

New Welding Method.—A new method has been devised for reclaiming scrap titanium sheet that results in a big saving of that scarce and expensive metal. The sheet metal is stacked and resistance-welded into a solid ingot of virgin metal which is as homogeneous and as strong as the original sheet. To prevent oxidation, the stack is immersed in a dielectric liquid during the welding process.

The method, devised by the *Glenn L. Martin Company*, Baltimore, Md., can also be used for reclaiming stainless steel or other costly metal or for building special shapes. So successful is the welding by the submerged method that it will be used for producing tapered sheets for aircraft wings by welding together step laminates to approximate the taper required and then machining to the exact taper.

Complex turbine wheels can also be made by stacking sheets, previously cut to shape, to form a solid center with the blades protruding.

Aluminum Rotor.—The new giant YH-16A Transporter helicopter, with rotors at each end of the 78-foot fuselage, has the 82-foot-diameter rotor blades made from formed plates of aluminum. The helicopter, which can carry 40 soldiers and 3 jeeps besides the crew, is built by the *Piasecki Helicopter Corporation*, Morton, Pa.

Plastic Tail Section.—A new Navy long-range patrol bomber has the tail section molded of glass-fiber-reënforced polyester resin. The plastic tail section is 17 feet long, 4 feet wide, and 6 feet high. It weighs 30 per cent less than a light-metal tail and costs 80 per cent less. Molding is done by the *Zenith Plastics Corporation*, Gardena, Calif.

A new line of cushioned abrasive wheels and disks has graded

EXTRUDED by ALCOA!

At a signal, aluminum — heated to an exact thermal degree—begins to flow through hardened steel dies. Trained eyes follow the wide, ribbed shape as it emerges to 30 feet . . . then 60 . . . then 90 . . . or 110 feet if necessary. The 14,000-ton "muscles" relax . . . another quality Alcoa extruded shape.

This extruded shape is one of the largest in the world . . . but the difference between it and others is much more than size alone. The men who handle the die design, the die construction, the preheating, the extrusion pressure . . . are all members of an Alcoa team. This team was selected by the Air Force to operate this and other presses in the "heavy press program"—the team with unmatched skill and 50 years' experience in the extruding process.

Larger extruded shapes, thinner and more intricate than ever before, are rapidly becoming the answer to rising costs of riveting and assembly. Your nearby Alcoa sales office is your short cut to 66 years of experience with aluminum. ALUMINUM COMPANY OF AMERICA, 850-G Alcoa Building, Pittsburgh 19, Pa.

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

"About those Gears ...let's check with Fellows first"

It always pays to "check with Fellows first". More than 50 years of experience in the diagnosis of the most intricate gear problems qualify Fellows engineers and craftsmen as experts.

Whenever the need arises, you are invited to draw on this valuable source of gear know-how. The answer to any gear problem, large or small, will be speeded by the application of Fellows precision manufacturing equipment.

Services like this have earned Fellows a reputation for leadership in the field of design and manufacture of complete equipment for cutting, finishing and testing gears.

Fellows

THE FELLOWS GEAR SHAPER COMPANY

Head Office and Export Department, Springfield, Vermont. Branch Offices: 323 Fisher Bldg., Detroit 2 • 5835 West North Avenue, Chicago 39 • 2206 Empire State Bldg., New York I.

silicon carbide grains evenly distributed in a resilient rubber. The wheels, produced by the *Weldon Roberts Rubber Company*, Newark, N. J., are being recommended for polishing stainless steel and for such operations as smoothing weld marks and for removing heavy tool marks from forged aluminum.

Sandwich Wall.—The siding of the new Air Force press plant at Cleveland, 1,063 feet long, 480 feet wide, and 100 feet high over the press bay, consists of a sandwich structure of 0.024-inch corrugated aluminum sheet with a one-inch layer of glass fiber insulation between the aluminum sheets. The insulating value of the "sandwich" is equal to a 12-inch masonry wall.

Lead-in Wires.—A new line of lead-in wires being marketed under the name of Temclad by *Hitemp Wires, Inc.*, Mineola, L. I., for electrical, electronic, and aircraft use, are not affected by solvents, have high dielectric strength, remain flexible at temperatures as low as minus 60 degrees Fahrenheit, and will withstand temperatures to 392 degrees. They are made with silver-plated stranded copper wires and have a solid insulation coating of Teflon fluorocarbon plastic covered with a braided glass fiber impregnated with Teflon in colors. The wire comes in sizes from 28 AWG to 10 AWG.

Transparent Plastic.—For sight glasses in chemical-processing equipment, the *M. W. Kellogg Company*, Jersey City, N. J., is offering flat transparent sheets of polytrifluoro monochloro ethylene plastic. The material is resistant to the action of most ordinary chemicals, retains good strength and resiliency at subzero temperatures, and will withstand heat to 300 degrees Fahrenheit. Standard sheet is ¼-inch thick.

Polyethylene Production.—Polyethylene got off to a small production start at the end of the war and is now the fastest growing plastic with a planned output of about half a billion pounds by 1956. It is a versatile material, with a wide variety of uses from thin film to tough electrical and mechanical parts and pipe.

Almost by accident *General Electric* discovered that by subjecting polyethylene parts to a short irradiation the thermoplastic is cross-linked into a harder and stronger thermoset resin that will withstand temperatures to 350 degrees Fahrenheit and is more chemical resistant.

Because parts can be made easily and rapidly with the original resin, and then transformed into the more durable material by passing them under the bombardment of high-energy cathode rays, a greatly expanded field of usefulness of the plastic is now visualized. General Electric is already commercializing the process.

The first product of its pilot-plant operation is a new insulating tape called Irrathene. Strong and resistant packaging film will also be produced, and expected applications for the near future are transparent, highly resistant, and unbreakable containers and bottles for foods and pharmaceuticals that will be capable of withstanding high-temperature sterilization. Ordinary polyethylene softens at about 165 degrees Fahrenheit and melts at 230 degrees.

Nylon-Diamond Belts.—For the polishing of such products as carbide dies, rolls, and ball-bearing races, the *Hartford Special Machinery Company*, Hartford, Conn., is marketing nylon belts with diamond particles embedded in the surface which not only makes a stronger resilient cushion for the abrasive than does rubber but also gives a belt that can be scoured without damaging the bond. The diamond grit is from the fine size of 1 to 5 microns up to 100 mesh, with color grading for identification. The belts, with widths to ⅜-inch, can be had in lengths to 104 inches.

CHRYSLER AIRTEMP

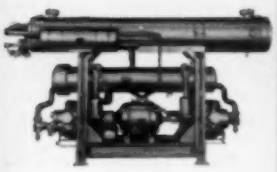
HAS THE BEST ANSWER FOR YOU!

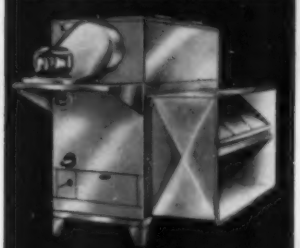
AIR CONDITIONING ?

Room Air Conditioners

"Packaged" Air Conditioner 2 thru 15 H.P.

Room Air Conditioner using hot—cold water

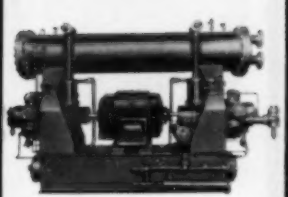

Water Chilling System


Air Handling Unit

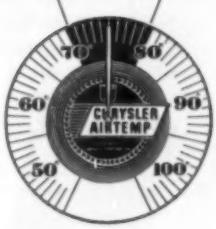
Evaporative Condenser

Cooling Tower

"Packaged" Air Conditioner 25, 40 and 60 H.P.


Compressor, 3 to 125 H.P.

LIVE IN THE Comfort Zone



Many factors affect the wise choice of air conditioning. First cost, operating cost, space available, individual control, required building alteration and maintenance are all important factors.

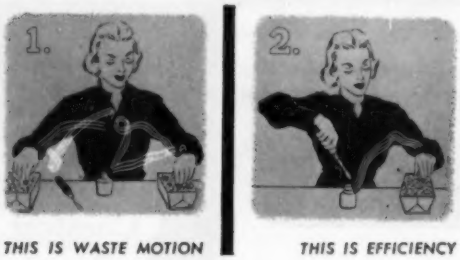
That's where Chrysler Airtemp comes in! Because of a COMPLETE line, we can be certain you get the BEST answer to your problem.

Through a wholly-owned subsidiary, Airtemp Construction Corporation, we can also put you in touch with a reputable contractor or consulting engineer in your area, who can survey your needs and see that the correct Chrysler Airtemp equipment is applied.

CHRYSLER AIRTEMP

HEATING • AIR CONDITIONING
FOR HOMES, BUSINESS, INDUSTRY
AIRTEMP DIVISION, CHRYSLER CORPORATION
DAYTON 1, OHIO

If you use bolts and lock washers for fastening assemblies... here's a suggestion for saving time and money. Substitute Reliance Springtites and Sems. You can reduce manual fastening time by ½ and multiply efficiency by 2.



THIS IS WASTE MOTION *THIS IS EFFICIENCY*

Savings result from the one piece design of these Reliance fasteners. By making the lock washer an integral and functional part of the bolt, production workers eliminate the steps of picking up a lock washer, slipping it in place and holding it until the piece is fastened. Production costs drop.

Engineering bulletin S-49 will give you more complete details. Write for a copy and it's yours. No obligation.

EATON MANUFACTURING COMPANY

EATON RELIANCE DIVISION

OFFICES and PLANTS 510 Charles Street, S.E., Massillon, Ohio

Sales Offices: New York • Cleveland • Detroit
Chicago • St. Louis • San Francisco • Montreal

Materials Progress

Rubber Pumps.—A line of centrifugal pumps of the *Vanton Pump & Equipment Corporation,* New York, N. Y., for handling alkalies, acids, and corrosive chemicals, are made largely of a Buna N synthetic hard rubber which has a tensile strength of 6,500 pounds per square inch, elongation of 4 per cent, hardness of 104 Brinell, and a heat distortion point of 248 degrees Fahrenheit. The casings and covers are of the solid hard rubber, and the hard-rubber impeller is reënforced with a metal insert. A carbon seal is used instead of the conventional packing.

High-Strength Parts.—The *U. S. Stoneware Company,* Akron, Ohio, is now offering wear-resistant and heat-resistant parts, practically equal in strength and hardness to a single-crystal sapphire, made by die pressing or extruding alpha alumina powder and then furnace sintering. The material, called Alite, is suitable for nozzles, extrusion die, textile guides, capacitator tubes, and refractory parts for tool fixtures. Parts can be machined or threaded before the sintering operation.

No bond is used with the alumina powder, and the bonding is by crystal growth across the grain boundaries during the firing, which produces a part that is essentially a single crystal with a tensile strength up to 26,000 pounds per square inch, a compressive strength up to 285,000 pounds per square inch, and a hardness about the same as a sapphire. The molded parts will withstand temperatures to 3,000 degrees Fahrenheit.

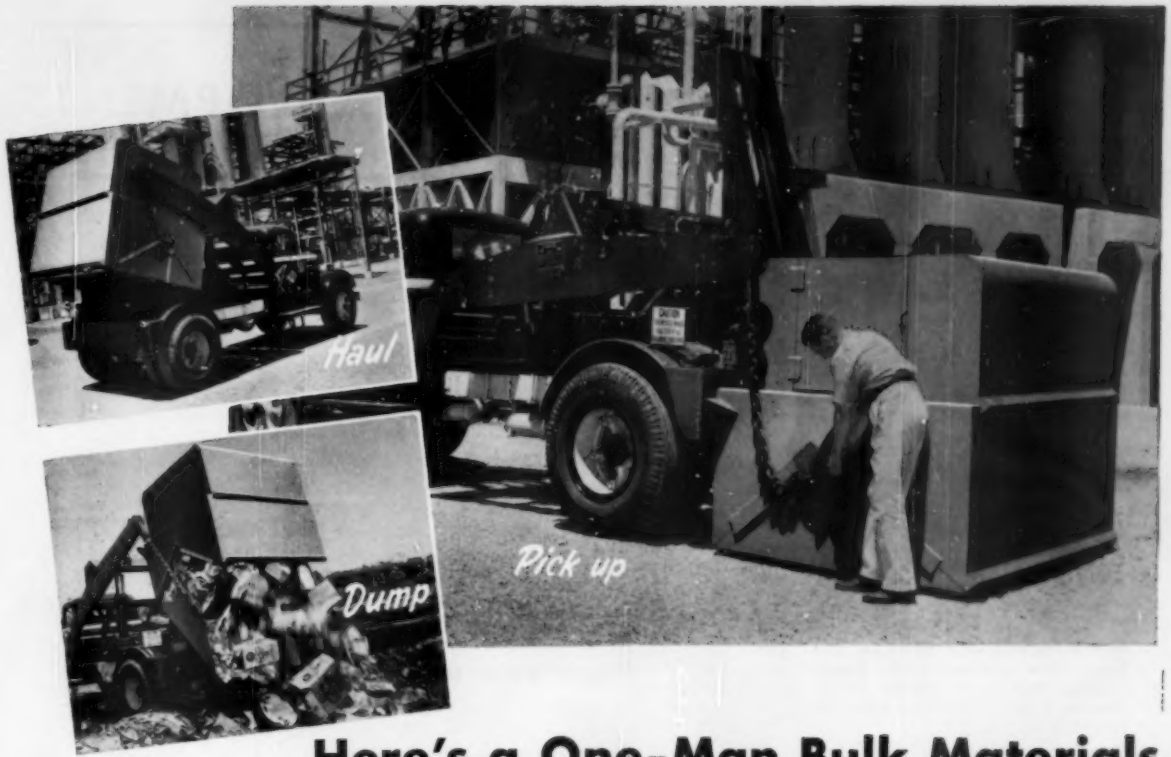
Plastic Tanks.—To take the place of alloy metal tanks containing scarce strategic metals, *Laminex Corporation,* Fall River, Mass., is offering noncorrosive plastic tanks that will withstand boiling temperatures and are easier to clean than metal tanks. Applications are for food and chemical plants and for electroplating, and almost any size or shape may be had, equipped with dam overflow and fittings. The tanks are made from glass-fiber-reënforced polyester resin plate with walls reënforced with ribs. They have only a fraction of the weight of metal tanks.

Hafnium Carbide.—Processes recently developed for the separation of hafnium from zirconium may make possible the commercialization of hafnium carbide as a refractory for extremely high temperatures and as a material for cutting tools and polishing abrasive. The blue-black crystalline carbide is made by heating hafnium oxide with carbon at 2,400 degrees Centigrade and purifying at 3,000 degrees.

The material is next to the diamond in hardness, with an average Vickers hardness of 2913, compared with 2400 for boron carbide. The powdered carbide is hot-pressed in graphite dies into cutting tools and other shapes. At present the *Union Carbide & Carbon Corporation,* New York, N. Y., is producing it only in experimental quantities.

New-Type Bearing.—A new type of self-lubricating bearing that has a low coefficient of friction, is readily machinable, and is highly resistant to solvents and to the corrosive action of chemicals is being produced by *Chemical & Power Products, Inc.,* New York, N. Y. The bearings are molded of a mixture of Teflon plastic, graphite, glass, and a molybdenum-sulphide type of resistant lubricant. They are suitable for such applications as pumps and chemical mixers.

Accurate Casting Process.—A permeable plaster of Paris casting process that gives unusual surface and dimensional accuracy to aluminum and magnesium castings has been introduced into the foundries of *Aluminum Company of America,* Pittsburgh, Pa. A tolerance of plus or minus 0.005-inch is possible in castings, and sharp corners can be cast. The process is particularly adaptable for casting hardware and other small parts, though it is not limited to such parts. Much machining can be saved by the better finish and the close tolerances.



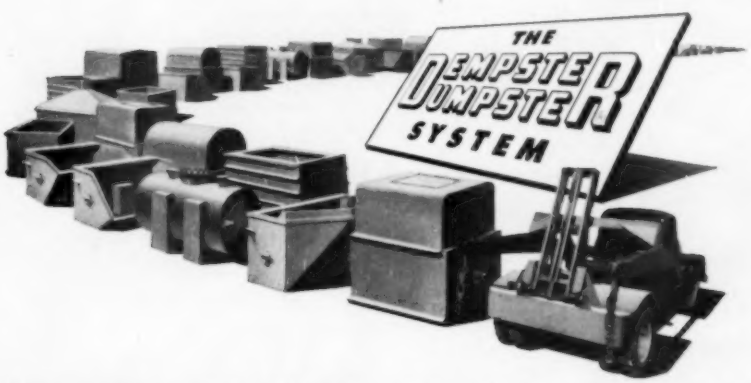
Here's a One-Man Bulk Materials Handling System for Your Plant...

In the Dempster-Dumpster System of bulk materials handling only one man, the driver of the truck-mounted Dempster-Dumpster, is required for operation. The Dempster-Dumpster serves scores of detachable Dempster-Dumpster Containers. Container capacities range up to 4 times that of conventional dump truck bodies and each container is designed to suit the materials to be handled—be they solids, liquids or dust . . . hot or cold . . . bulky, light or heavy. You simply place these containers at convenient materials accumulation points inside or outside buildings. When loaded each container is picked up, hauled and emptied (as shown above) or load set down intact. Entire operation is handled by hydraulic controls in cab.

Containers shown below are just a few of the many available or that can be built to meet your needs. They enable you to handle, at tremendous savings, materials of many descriptions—trash and waste materials, raw materials, finished products, etc. —with only one truck and only one man, the driver.

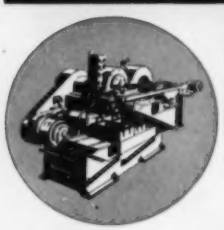
Without question, the Dempster-Dumpster System is the most economical and most efficient method of plant materials handling by truck ever devised!

Write to us for complete information. Manufactured exclusively by Dempster Brothers, Inc.

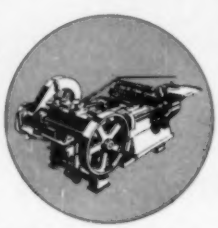


DEMPSTER BROTHERS, 974 Shea Building, Knoxville 17, Tennessee

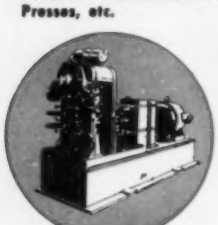
FIVE KINDS OF MASS PRODUCTION METALWORKING MACHINERY by Waterbury Farrel



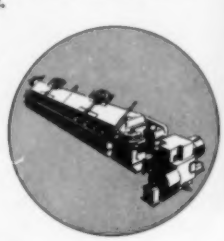
COLD PROCESS BOLT & NUT MACHINERY —Headers (all types) • Rivet Machinery Trimmers • Thread Rolling Machines Slotters • Nut Formers and Tappers, etc.



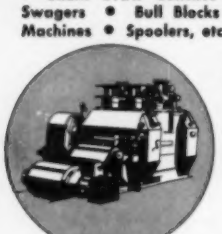
POWER PRESSES — Crank, Cam and Toggle; also Rack and Pinion Presses • Eyelet Machines • Multiple Plunger Presses • Horizontal and Hydraulic Presses, etc.



MILL MACHINERY — Rolling Mills: Strip, Rod, Tube, Wire Flattening, (For Ferrous and Non Ferrous Metals) • Also Slitters • Straighteners • Cut-off Saws • Coilers • Winders, etc.

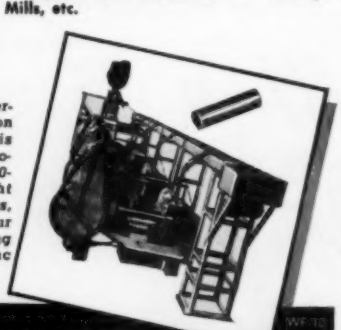


WIRE MILL EQUIPMENT — Continuous Wire Drawing Machines (Upright Cone and Tandem) • Wire Flattening Mills • Chain Draw Benches • Pointers • Swagers • Bull Blocks • String-up Machines • Spoolers, etc.



SPECIAL MACHINERY — Sendzimir Mills • Small Arm Ammunition Machines • Thread Rolling Machines For Shells • Collapsible Tube Machines • Coining Mills, etc.

HERE'S A SAMPLE of Waterbury-Farrel mass production equipment in action. This complete WF automatic production unit combines a 40-ton double-acting, upright blanking and cupping press, a conveyor feed and four 7-station horizontal drawing presses to draw 340 zinc shells per minute.



WATERBURY FARREL FOUNDRY & MACHINE CO.
WATERBURY, CONN.
Offices: Chicago, Cleveland and Millburn, N. J.

NEW DEVELOPMENTS

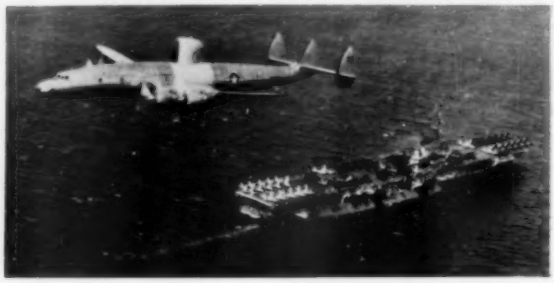
MULTIUSE ALLOY

The Naval Ordnance Laboratory has announced the development of Thermenol, a high-temperature alloy of noncritical metals, showing promise as a substitute for certain stainless steels in many applications. Thermenol is a modification of the magnetic material, 16-Alfenol, which was developed in the NOL Magnetics Division as a noncritical "soft" magnetic material. Metallurgists working in the laboratory found that by making small additions of such metals as vanadium or molybdenum, coupled with suitable heat treatment, the heat resistance of the alloy was increased and a new group of heat-resistant alloys resulted.

Thermenol is one member of this family. It is twenty to twenty-five per cent lighter than stainless steel, and its physical characteristics include a high tensile strength coupled with a high resistance to corrosion or oxidation. Laboratory tests pointed to the suitability of the material for use in such highly important items as jet engines.

TWO IF BY SEA

The U.S. Navy's new sky-and-sea fighting team consists of a Lockheed WV-2 flying-eye radar airplane and a carrier load of fighters it can direct into battle when it electronically spots danger in front of the fleet. Navy officials said development of



The Lockheed WV-2 radar airplane in action.

high-altitude radar planes, able to "see" over thousands of square miles of ocean, afford protection never before possible.

Day or night, the 31-man WV-2 crew can keep watch on the outskirts of Navy task forces. If enemy surface ships or planes appear, singly or in numbers, the WV-2 can spot and track them, radioing warning to the fighters below.

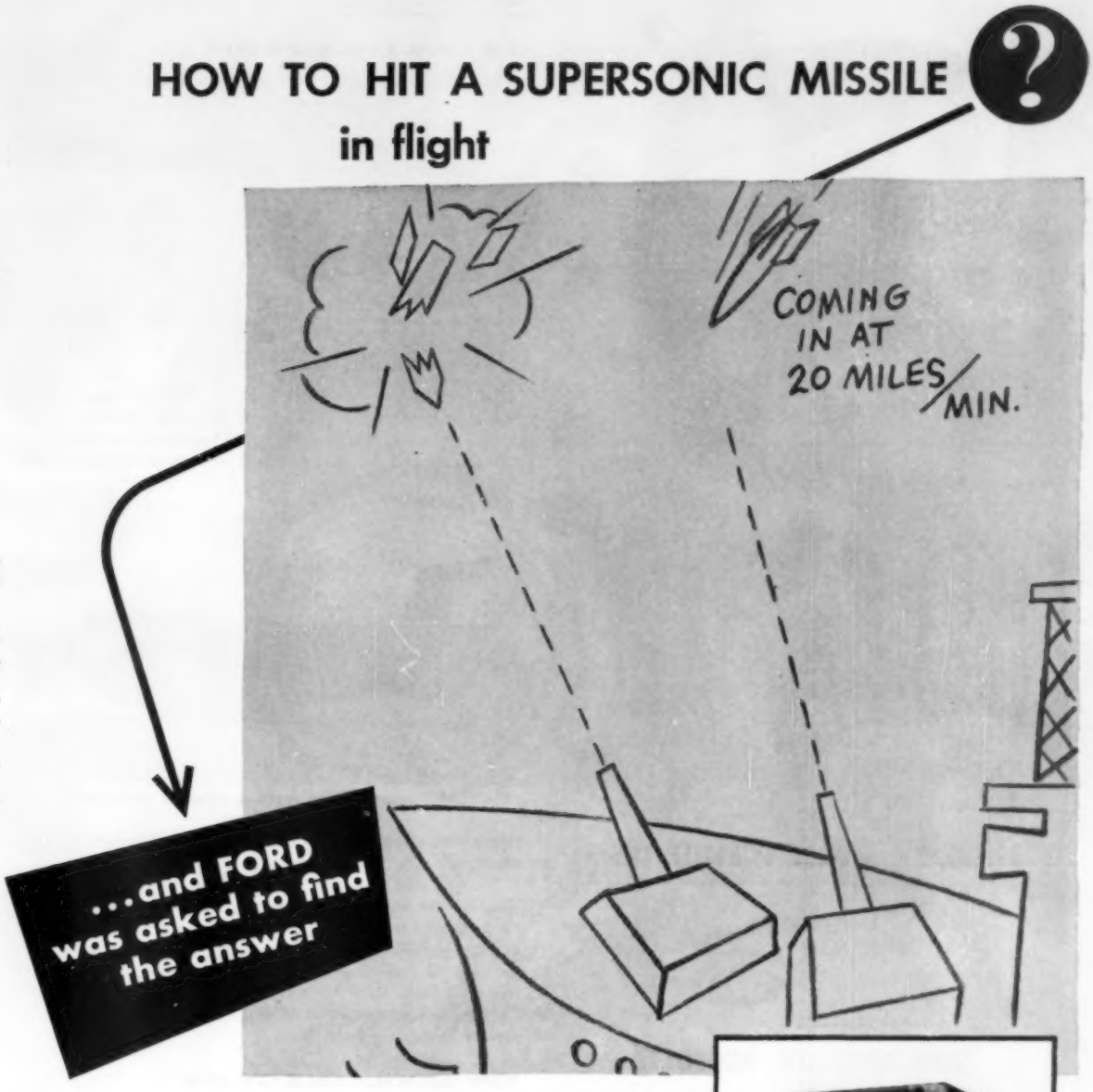
The hump on the plane's back contains radar antenna. The huge craft, big as a Super Constellation airliner, is 113½ feet long with a 123-foot wingspread.

HIGH-SPEED TREPANNING

A speed-increasing device that permits a quick shift between a low-speed and a high-speed range is an unusual feature of a 124-foot-long trepanning lathe at the Torrance, Calif., plant of the National Supply Company.

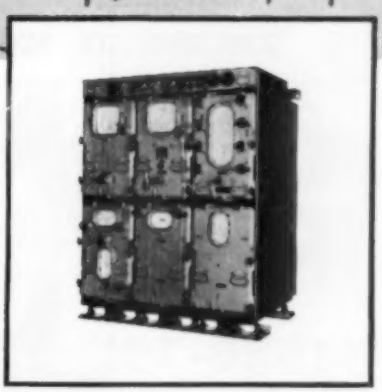
The lathe is used in the industrial products division of the plant for work requiring high-speed, deep-hole precision boring. Peneration rates in excess of 4 inches a minute on a 5¼-inch-diameter hole 26 feet deep are commonplace. Holes up to 8⅞ inches in diameter, in lengths over 40 feet, have also been successfully trepanned. For a normal setup, workpieces up to fifty feet long may be trepanned. *(Continued on p. 96)*

HOW TO HIT A SUPERSONIC MISSILE in flight



An enemy guided missile comes winging towards our task force . . . at speeds of up to 20 miles a minute. What kind of computer can predict and compute the necessary data fast enough to shoot down the missile . . . and be reliable every time? That was the problem posed to Ford Instrument Company engineers . . . and in cooperation with the Navy, they found the answer. Compact equipment, housed in easy-to-service units . . . that stand at the front line of our defense.

This is typical of the problems that Ford has been given by the Armed Forces since 1915. For from the vast engineering and production facilities of the Ford Instrument Company come the mechanical, hydraulic, electro-mechanical, magnetic and electronic instruments that bring us our "tomorrows" today. Control problems of both Industry and the Military are Ford specialties.



22

You can see why a job with Ford Instrument offers young engineers a challenge. If you can qualify, there may be a spot for you in automatic control development at Ford. Write for brochure about products or job opportunities. State your preference.

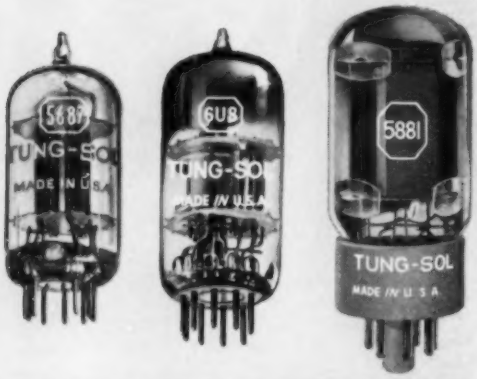
FORD

FORD INSTRUMENT COMPANY

DIVISION OF THE SPERRY CORPORATION

31-10 Thomson Avenue, Long Island City 1, N. Y.

PICTURE TUBES



RADIO, TV, SPECIAL PURPOSE TUBES

SEMICONDUCTOR PRODUCTS

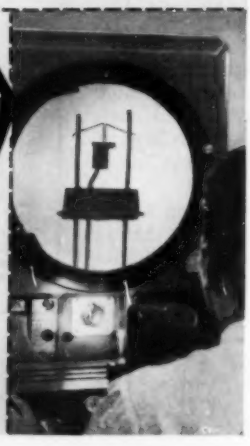
PLUS—ALL THE TECHNICAL SERVICE THAT GOES WITH THEM

TUNG-SOL 50 YEARS ACHIEVEMENT

TUNG-SOL®
Electric Inc.,
Newark 4, New Jersey

Sales Offices: Atlanta, Chicago, Columbus, Culver City (Los Angeles), Dallas, Denver, Detroit, Newark, Seattle.

Tung-Sol also makes: All-Glass Sealed Beam Lamps, Miniature Lamps and Signal Flashers.



New Developments

NEW LOOK IN SUBMARINES

The U.S.S. ALBACORE (AGS-569), a submarine of advanced hydrodynamic form, completed in March at the Portsmouth Naval Shipyard, is the result of far-seeing planning by the Navy Department in the field of undersea warfare. It is the realization of a long-recognized need for an experimental submarine to permit the Navy Department to develop and apply, on a basis of realistic full-scale tests, the many advanced technological possibilities now available.

Safety, habitability, and control were emphasized, but surface performance was subordinated to high submerged speed. A thorough study of airship research and other previous work was made and was the basis of the new submarine's design.

ANTISUB SEAPLANE

The first production model of the U. S. Navy's largest anti-submarine-warfare seaplane made its first flight recently. Designated the P5M-2 Martin Marlin, it is equipped with the latest electronic devices designed to search out enemy submarines and

The P5M-2 antisubmarine seaplane takes off on maiden flight.

armed with a lethal load of depth charges and rockets for their destruction.

The new Marlin is easily distinguished by its high "T" tail. Used for the first time as a seaplane, this configuration moves the horizontal tail surface up to the top of the vertical stabilizer, thereby providing increased efficiency and at the same time reducing the over-all weight and drag of the assembly. Increased power in the form of advanced 3,400-horsepower Wright Cyclone turbocompound R-3350-32W engines give the P5M-2 greater range and more speed.

NEW 20-MM. AIRCRAFT GUN

A new 20-mm. automatic gun with a considerably higher rate of fire than any aircraft gun now in operation has been developed for use in the latest combat airplanes, including transonic and supersonic aircraft, of the U.S. Air Force. (See illustration on page 40.)

Named the M39, it is a relatively lightweight, electrically fired, gas-operated machine gun. It fires an explosive projectile with greater rapidity and higher muzzle velocity than the 1,200-rounds-a-minute caliber .50 machine gun now used in many Air Force aircraft.

The new weapon is a product of the close teamwork existing between private industry, the U.S. Army, and the U.S. Air Force. Ford Motor Company accomplished the major share of research and development following the initial development by Armour Research Foundation.

Both companies were working under contract to the Ordnance Corps, which in turn conducted this program for the U.S.A.F. Other agencies participating were Springfield Armory, Aberdeen

You have to keep fishing

... if you want to keep your skill

Spicer has been in the center of the stream
of automotive progress for 50 years.
Consistently . . . *year after year for a half-century* . . . Spicer has built
up a rich fund of power transmission knowledge and skill.
In peace and war . . . in every phase of civilian and military service . . .
Spicer automotive equipment has convincingly demonstrated why
it has earned the reputation of

"The Standard of the Industry"

ENGINEERING

DANA

MANUFACTURING

SPICER
POWER TAKE-OFFS

...built with the skill gained from 50 continuous years of experience in power transmission design

Spicer Power Take-Offs and Spicer Power Take-Off Joints embody all the advantages of Spicer engineering, Spicer precision manufacturing, and Spicer dependable performance. These units are available in a wide range of models to meet every service requirement. They are more widely used than any other similar type of equipment.

Spicer engineers offer the benefit of their vast experience to assist you in the adapting of Spicer Power Take-Off units to the particular needs of your product. Spicer Power Take-Offs are designed to meet all operating conditions of continuous or intermittent service. They include Medium and Heavy Duty Single, Dual and Reversible Speed Models for all service vehicles. For many years Spicer units have been

"Preferred by the Trucking Industry!"

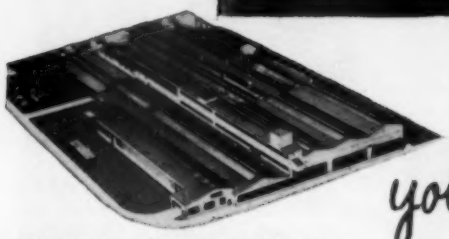
SPICER MANUFACTURING DIVISION
of Dana Corporation
Toledo 1, Ohio

50 YEARS OF Spicer SERVICE

ENGINEERING
DANA
MANUFACTURING

TRANSMISSIONS • UNIVERSAL JOINTS • PROPELLER SHAFTS • BROWN-LIPE and AUBURN CLUTCHES • FORGINGS • AXLES • STAMPINGS • SPICER BROWN-LIPE GEAR BOXES • PARISH FRAMES • TORQUE CONVERTERS • POWER TAKE-OFFS • POWER TAKE-OFF JOINTS • RAIL CAR DRIVES • RAILWAY GENERATOR DRIVES • AIRCRAFT GEARS • WELDED TUBING

Production Heat Treatment



The big modern Riverside Foundry at Bettendorf, Iowa

Let Riverside help you solve your steel casting problems

Riverside Foundry is ready to give you excellent service on all ordnance castings. **In fact, any steel casting specifications for which your contract might call.** We have a full staff of men who have spent years producing ordnance material. Our customers include many great names of American Industry: Chrysler, American Locomotive, International Harvester, Fisher Body, Massey-Harris Co., Bowen-McLaughlin-York, Inc. and Ford Motor Company. **Ask them about Riverside.**

Call or write us at Riverside today

For a dependable qualified source of steel casting requirements, see Riverside. You give us your drawings. The rest of the job is ours. Save yourself time, worry and loss of production. We are ready to do a complete job for you on any casting requirement.

Structural soundness is checked by means of the X-ray machine.

BETTENDORF, IOWA

RIVERSIDE FOUNDRY

Bettendorf, Iowa Davenport Exchange 5-1811

STEEL and GRAY IRON CASTINGS

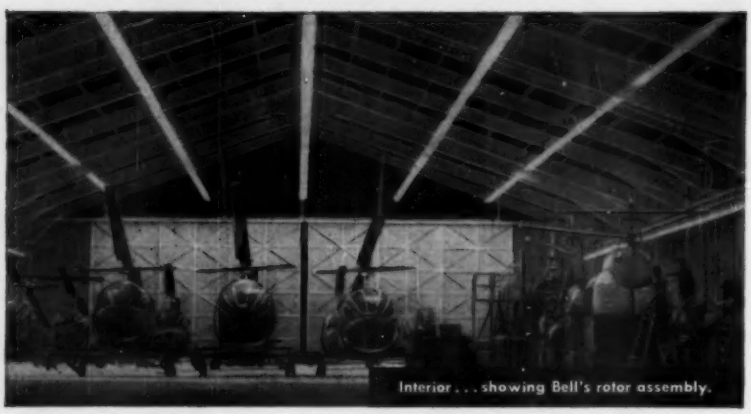
ANOTHER INDUSTRIAL LEADER...

Exterior view of new Luria installation.

BELL Aircraft CORPORATION
TEXAS DIVISION

Chooses

LURIA Standardized Buildings



Interior . . . showing Bell's rotor assembly.

THE "LURIA SYSTEM OF STANDARDIZATION" LOWERS YOUR BUILDING COSTS . . . AND ADDS HIGH SPEED TO YOUR INDUSTRIAL EXPANSION

One of the primary reasons why Luria Buildings were selected by Bell Aircraft . . . and became a vital part of the world's most up-to-date facilities for manufacturing helicopters . . . was because these standardized buildings of structural steel components *surpass the requirements called for in the building codes.* But *permanency of structure* is just one of many assets provided by Luria. Among the others are *adaptability* and a *flexibility of design* that make possible almost *any* type of structure and almost *any* type of architectural treatment. As a result, Luria Buildings can be "custom-built" to your *individual* requirements . . . without sacrificing the advantages of standardization.

LURIA ENGINEERING Company

511 FIFTH AVENUE, NEW YORK 17, N. Y.

District Offices: ATLANTA • PHILADELPHIA • BOSTON • CHICAGO • WASHINGTON, D. C.

New Developments

Proving Ground, and Wright Air Development Center. Pontiac Motor Division of General Motors is currently mass producing the gun under an Army Ordnance contract for the Air Force.

The gun weighs approximately 170 pounds. It throws a shell which bursts after penetrating the target. Its high firing rate is made possible by the 5-chamber revolver-type cylinder which moves ammunition through the feeding, firing, and extracting phases at a greater rate than a reciprocating bolt-type mechanism.

FIRE-CONTROL COMPUTER

A new type of aircraft fire-control computer has been developed with a weight reduction from 12½ to 3½ pounds, an increase in the number of computations performed, a reduction in cost, and an improved performance and reliability. Through the collaboration of Servomechanisms, Inc., and Electro-Mec Laboratory, Inc., a system of standardized "package servo components" and "ultra-ultra"-low-torque potentiometers have made possible an unusual example of miniaturization and design refinement.

Old computer, left, compared with the smaller and lighter redesigned unit, right.

UNDERWATER COMMUNICATIONS

A new underwater communications system, the first leg of which has been completed, is expected to facilitate analysis of missile flight data at the Air Force Missile Test Center, Fla.

The first part of the system, stretching from Cape Canaveral, southeast through the Bahama Islands to Grand Turk Island, a distance of almost 1,000 miles, follows the Air Force missile test range along the route over which guided missiles are fired.

Sixteen carrier telephone repeater stations along the route provide amplification facilities for signals transmitted over the system's twelve 2-way high-quality voice channels.

MAGNETIC MEMORY

The new magnetic "memory" that increases by six times the information-storage capacity of ENIAC, first of the electronic "giant brains," was installed by engineers of the research center of Bur-

"TAILS" FOR 2000 POUNDERS GET DOUBLE-DIP FINISHING

The orderly "parade of giants" shown here took considerable planning and work. It is the combined achievement of Poloron Products, Inc., of Scranton, Pa., and Glidden Technical Servicemen.

First of all, oversize dip tanks were required to meet the rigid finishing standards. This led to the development of special primers and enamels, custom-made by Glidden for use in the tanks. In addition, these finishes met all government specifications for even coating, film thickness, and resistance characteristics.

Unusual? Yes, but no more so than the thousands of finishing jobs Glidden Technical Service experts are called upon to solve every year. This is typical of the Glidden policy of helping manufacturers find the best finishing methods for each product need.

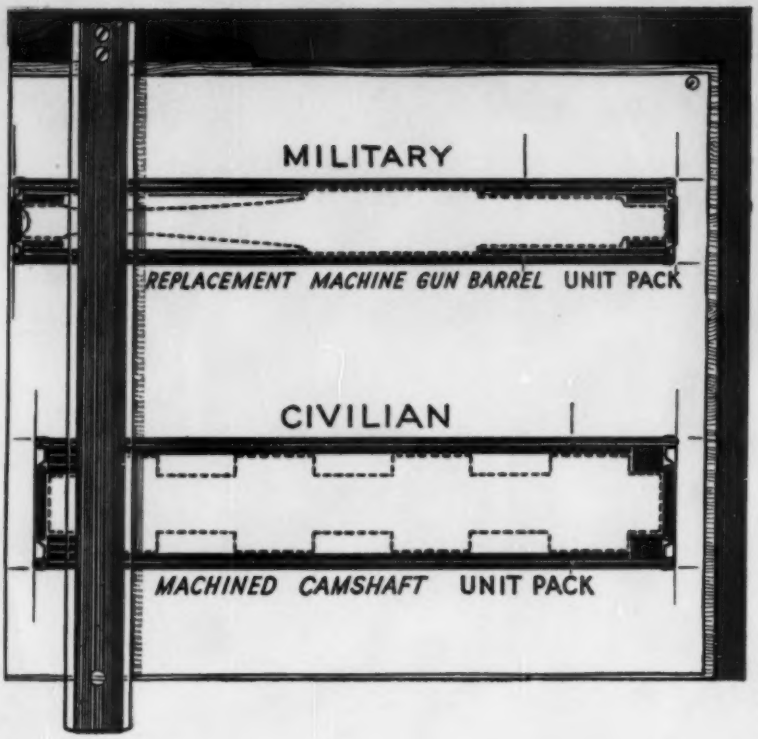
THE GLIDDEN COMPANY

INDUSTRIAL FINISHES DIVISION

11005 MADISON AVENUE • CLEVELAND 2, OHIO

SALES OFFICES AND FACTORIES:

San Francisco, Los Angeles, Chicago (Nubian Division—1855 N. Leclaire Ave.), Minneapolis, New Orleans, St. Louis, Cleveland, Reading, Atlanta. Canada: Toronto and Montreal



CLEVELAND CONTAINERS

for both MILITARY AND CIVILIAN USES . . .

Military spare parts, highly machined metal parts, delicate electro-mechanisms and fragile items can be packaged better, and at less cost, in fibre containers.

CHECK THIS LIST OF ADVANTAGES

. . . May be constructed to meet all the requirements of Methods IA, II and IC4 Packaging, under approved military specifications.
. . . Low cost.
. . . Economical cubage and weight.
. . . Reduction or elimination of intermediate and overpacks.
. . . Tailored to your product—built in cushioning, special barriers and liners where required.
. . . High resistance to side impact, bending and compression.
. . . High intraplant and feeder plant re-use.

The Cleveland Container Company offers skilled engineering help. Take advantage of the convenience and economy available in fibre containers.

Why pay more? For Good Quality . . . Call Cleveland!

The CLEVELAND CONTAINER Co.
6201 BARBERTON AVE. CLEVELAND 2, OHIO
• All-Fibre Cans • Combination Metal and Paper Cans
• Spirally Wound Tubes and Cores for all Purposes

PLANTS AND SALES OFFICES: Cleveland, Chicago, Detroit, Memphis, Plymouth, Wisc., Ogdensburg, N. Y., Jamesburg, N. J., Los Angeles • ABRASIVE DIVISION at Cleveland. SALES OFFICES: Grand Central Terminal Bldg., New York City; Washington Gas Light Bldg., Washington, D. C.; West Hartford, Conn.; Rochester, N. Y.

Cleveland Container Canada, Ltd.: PLANTS AND SALES OFFICES: Toronto and Prescott, Ont. • SALES OFFICE: Montreal.

New Developments

roughs Corporation in Philadelphia. Housed at the Army's Ballistics Research Laboratories, Aberdeen Proving Ground, Md., the ENIAC can now "remember" 120 words instead of 20 as formerly.

The memory accepts information at the rate of 50,000 words a second—a "word" being a 10-digit number such as 9,547,-989,462. The high rate of reading and storing information is made possible by the use of a new type of magnetic unit designed by Burroughs and used for the first time in this memory. Four panels of 1,025 memory cells make up the storage section of the new device. Each of the 4,100 cells consists of a core of special metal wound with two separate windings of insulated wire.

SEMIAUTOMATIC SHOTGUN

The first semiautomatic shotgun that is said to stay on target shot after shot as fast as the trigger is pulled was unveiled recently by Winchester Repeating Arms

Model 50 Winchester shotgun.

Company after sixteen years of research. The new Model 50 is the first self-loading shotgun with a nonrecoiling barrel and an independent chamber which moves less than one-tenth of an inch. This small movement actuates the breech bolt and starts the entire cycle of unlocking, extraction, reloading, and locking.

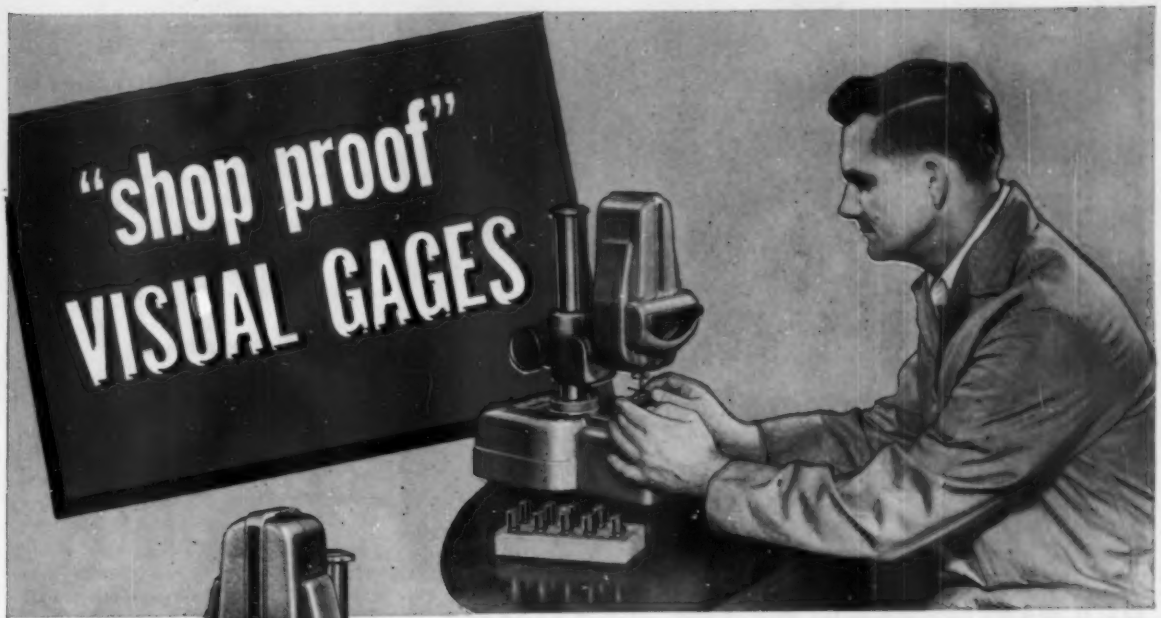
The recoil effect of the Model 50 is said to be twenty to thirty per cent "softer" than other semiautomatics.

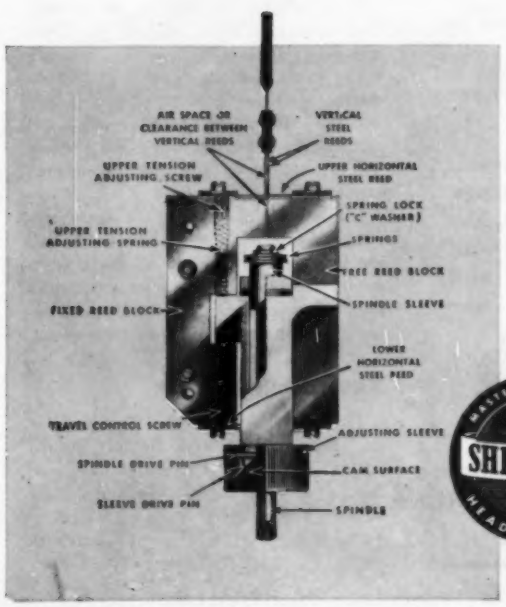
NEW AMPHIBIOUS VEHICLE

An improved new amphibious assault vehicle is now in production for the Marine Corps. Developed by the Ingersoll Products Division of the Borg-Warner Corporation, the new vehicle is called the LVTP-5 and combines the amphibious qualities of the old LVT with improved speed, range, and maneuverability to give future Marine assault landing forces a mechanized capability never before attainable in the initial phases of an amphibious operation.

FIRE-FIGHTING SUIT

Development of an aluminum-coated fire-fighting suit which can withstand ten per cent more heat than standard fire-





Here are gages you can trust—they're "SHOP PROOF". In thousands of plants they are considered the one best comparator for measuring external dimensions including 3-wire check of pitch diameter. "SHOP PROOF!"

VISUAL GAGES are rugged and sturdy. Repeated tests of 100,000,000 gaging operations have shown no wear on the Reed Mechanism. It is the simplest, most positive and most inherently accurate magnifying mechanism for precision measuring ever built. "SHOP PROOF!"

"Movement without friction"—that's the Reed Mechanism. There are no rubbing contacts, no gears or backlash. No knife edges to flatten or break, no lost motion. Electricity is used only for illumination—unaffected by voltage fluctuations—only a lamp bulb to replace at rare intervals. "SHOP PROOF!"

Yet VISUAL GAGES are sensitively accurate, graduated in 100, 50, 25 or 10 millionths of an inch, according to the model. "SHOP PROOF!"

Many VISUAL GAGES have a performance record from five to more than 20 years in Receiving, Final and Production Inspection and in gaging at the machine. They have not become obsolete—they're "SHOP PROOF!"

***PHONE, WIRE OR WRITE for Catalog #500-54—there's a Visual Gage to suit your range of requirements. And it is "SHOP PROOF!"* Gage Division, The Sheffield Corporation, Dayton 1, Ohio, U. S. A.**

6771

SHEFFIELD MASTER CRAFTSMAN HEADQUARTERS **SHEFFIELD**

PEARLITIC MALLEABLE CASTINGS as engineers see its many advantages

DESIGN ADAPTABILITY: Because of its good fluidity, it can be cast in thin sections and in complicated shapes.

HIGHER STRENGTH: Ultimate strengths range between 60,000 and 90,000 psi; yield strength between 40,000 and 70,000 psi.

EASILY MACHINED: Machinability index (B1112 Steel = 100) ranges between 80 and 90.

WEAR RESISTANCE: Withstands excessive wear under heavy loads at high speeds.

LOCALIZED HARDENING: Sections of the casting can be flame hardened or induction hardened before or after machining.

BEARING PROPERTIES: Good non-seizing properties in metal-to-metal contact.

FINE FINISH: Can be given a very smooth finish where desired.

You will find many applications for Pearlitic Malleable castings – particularly as a replacement for forgings, stampings and weldments – where reduced weight, less machining time, fewer assembly operations and better appearance are important production and sales considerations. A-9277

NATIONAL MALLEABLE AND STEEL CASTINGS

M&S Co. EST. 1868

COMPANY

Cleveland 6, Ohio

The Nation's largest independent producer of malleable and pearlitic malleable

New Developments

resistant clothing has been announced by the Army Quartermaster Corps. The new clothing, which consists of a jacket and trousers, is lighter than those now used by firemen. The suits are made of 8.5-ounce duck treated for fire resistance and coated with neoprene, a type of synthetic rubber, for waterproofness. A thin outer layer of aluminum is deposited on the fabric to help reflect radiant heat.

JET ENGINE BRAKE

Boeing Aircraft Company, has developed practical designs for jet-engine "reverse-thrust" devices to enable jet transports, bombers, and fighters to operate from the majority of existing airports. The new jet brakes divert the tremendous power of jet engines to slow down aircraft once the wheels have touched down on a runway. The Boeing device consists of a "clamshell" thrust reverser which deflects forward the flow of fast-moving gases from a jet engine's tailpipe and thus decelerates the airplane. About forty five per cent reversal of jet thrust is thus possible.

ELECTRON MICROSCOPE

Radio Corporation of America recently revealed an electron microscope reported to be twice as powerful as any now in use. It will permit study of particles smaller than one ten-millionth of an inch in diameter. Photographs taken by an automatic camera inside the instrument can be enlarged up to 200,000 times the size of specimens.

SUB SIMULATOR

The Navy has contracted for a dry-land submarine to be built by the Electric Boat Division of General Dynamics Corporation, Groton, Conn. The "submarine simulator trainer" will be firmly anchored to a land-based cradle and many of the effects of a sea-going vessel will be registered only on instruments inside the device.

Planned at the request of the Navy Submarine School, New London, Conn., the trainer will duplicate all the characteristics of the Navy's newer submarines even to reproducing in detail the control room of a modern attack-class vessel.

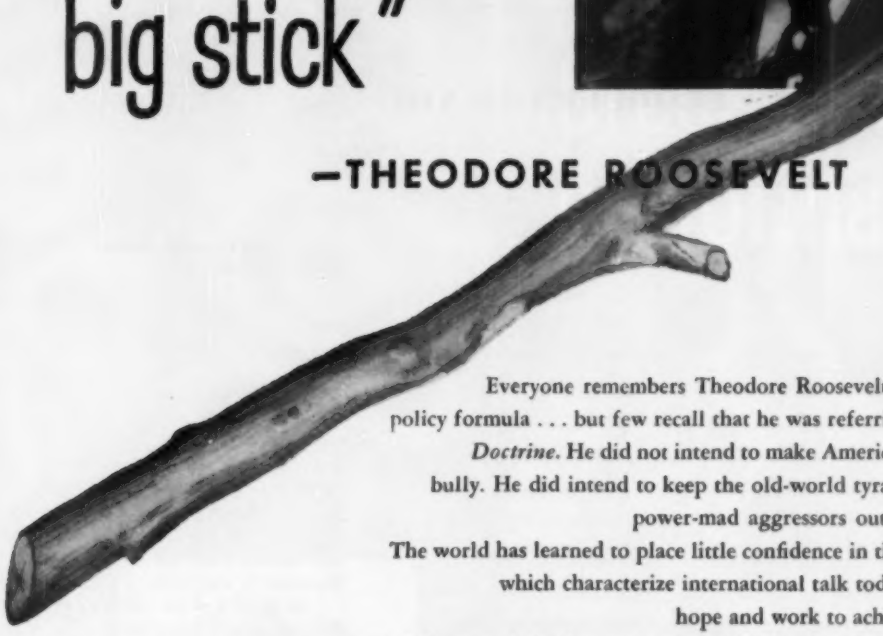
NEW ROCKET GUN

The Air Force recently displayed for the first time a new fighter-mounted rocket gun, the T110, which was fired by a Northrop F-89C Scorpion fighter against a part of a B-24 fighter. The rocket gun blew the obsolete bomber to bits.

Guide words for today

"Speak softly and carry a big stick"

—THEODORE ROOSEVELT



Everyone remembers Theodore Roosevelt's famous foreign policy formula . . . but few recall that he was referring to the *Monroe Doctrine.* He did not intend to make America an international bully. He did intend to keep the old-world tyrants, dictators and power-mad aggressors out of the Americas. The world has learned to place little confidence in the loud harangues which characterize international talk today. While we still hope and work to achieve lasting peace, it behooves all the free nations to heed Theodore Roosevelt's advice . . . to speak softly, and to build the defensive strength which will give meaning to their words.

President

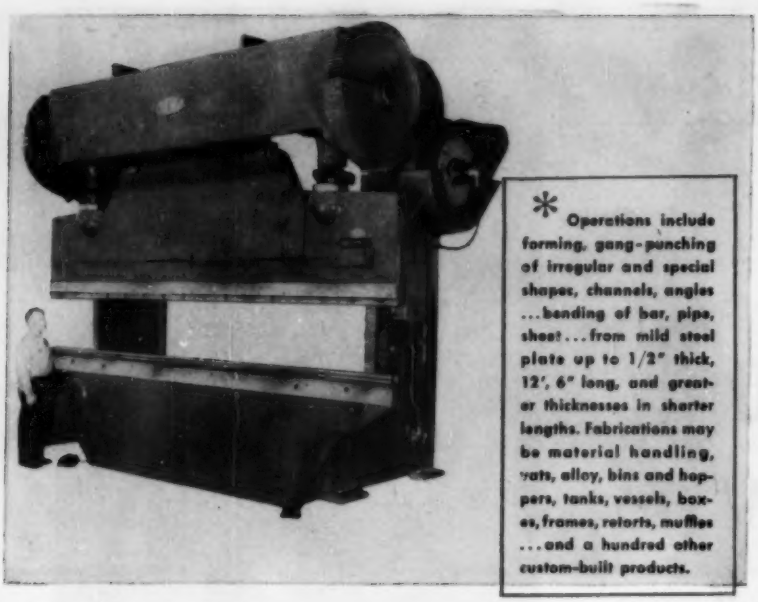
DUTY HONOR COUNTRY
LABOR BUSINESS GOVERNMENT

AUDOGRAPH

The Gray Manufacturing Company, Hartford 1, Connecticut

Makers of Audograph and PhonAudograph Electronic Soundwriters

AND GRAY RESEARCH AND DEVELOPMENT CO., INC., Specialists in Video, Audio, Sub-Audio Electronic Mechanisms



* Operations include forming, gang-punching of irregular and special shapes, channels, angles ...bending of bar, pipe, sheet ... from mild steel plate up to 1/2" thick, 12', 6" long, and greater thicknesses in shorter lengths. Fabrications may be material handling, vats, alloy, bins and hoppers, tanks, vessels, boxes, frames, retorts, muffles ...and a hundred other custom-built products.

I AM A NEW MACHINE
ALL SET TO PRODUCE FOR YOU

The name, gentlemen, is Chicago Press Brake, and I have just been installed in the plant of Rolock Incorporated, Fairfield, Connecticut. They have asked me to speak for myself.

First of all, you can see that I'm a husky specimen . . . 17 ft. in height, 80,000 lbs. in weight . . . with a tremendous capacity for producing heavy work. I have joined the Rolock machinery group partly to lower costs and speed production of our fabricated heat and corrosion resistant alloys . . . and also to handle larger and stronger components for the chemical and food processing fields.

I shall be working with highly experienced engineers, fabricators and welders, who have made Rolock a top name for supplying engineered-to-the-job Heat Treating equipment for the country's leading metal working plants.

So, as the most versatile tool in any fabricating plant, Rolock is offering my products for the solution of your problems concerned with fabrications * you may require. Mr. Roger P. Welles, President of Rolock Incorporated, has suggested that you write to him, personally, for discussion of your needs . . . and, if desired, our engineering recommendations.

5RL54B

ROLOCK INCORPORATED
1356 KINGS HIGHWAY, FAIRFIELD, CONNECTICUT

COMMUNICATIONS

BLUNT-NOSED PROJECTILE?

THE EDITORS.—There are various ways of solving the Army Ordnance problem of making the bazooka projectile more accurate. Having done a great deal of work on the projection of steel cables by rockets, I am convinced that the accuracy of any low-velocity shell, or any shell that does not have major stability provided by high-speed rotation, would be greatly increased by merely cutting off its nose to a completely blunt surface so that it shears the air.

The moment of a low-velocity or non-spin-stabilized projectile with a round or pointed nose has its axis aiming in a line different from its line of flight. High air pressure is developed on the side of the nose toward the line of flight with a corresponding low pressure on the outside, and these forces tend to drive the projectile still further off the line of flight, thus forcing a much greater load on the fins (or gyros) to stabilize it.

WADSWORTH W. MOUNT
Summit, N. J.

THOUGHTS ON NEW WEAPONS

THE EDITORS.—Of the utmost importance to all of us, whether we be military or civilian, is the impending selection of a new infantry weapon. I hesitate to call this a rifle because it has been decreed that this weapon shall suffice to take the place of the light machine gun and the automatic rifle as well as the submachine gun and carbine (which in turn is supposed to take the place of the pistol), all the while retaining the physical characteristics of the rifle. Rather a big order in any event!

The purpose of the consolidation of all these types into one weapon is very commendable inasmuch as the resulting simplification of spare-parts and ammunition supply would be a welcome asset in any conflict. However there arises a question of just how practical this is. For a minute let us consider the ammunition problem.

The recently adopted T65 cartridge is a shortened version of the caliber .30 M2 (as well as the other M1 and .30/06 versions) and eventually will replace the present service load. Unfortunately it entails more than a rechambering job to change the present weapons over to use it in case of an emergency as we are led to believe by many "arms experts."

When the alterations to the barrels, stocks, gas mechanisms, barrel jackets,

beyond the sonic wall

precision *spells* performance!

New heights of performance, demanded by supersonic flight, also demand new standards of precision . . . precision assured by the know-how and production facilities with which we have served the aviation industry in development work for many years.

We manufacture precision gear assemblies for accessory drive units, actuators, transmissions, computers and controls. And we also produce complete components such as bomb hoists, gun turrets, radar tracking and scanning assemblies, hydraulic actuators.

Make **your** development and production problems **our** problems. We're qualified by long and proven performance to solve them . . . large or small. A letter or telephone call will put us at your service.

THE STEEL PRODUCTS ENGINEERING CO.

ENGINEERS AND MANUFACTURERS • SPRINGFIELD, OHIO

Your mark of Ordnance loyalty

A.O.A. INSIGNIA

Lapel Emblem

Lapel Bar

Ribbon Lapel Rosette

Medal

Available only to Association members, the official insignia will identify you as a loyal A.O.A. supporter, and a patriotic American. You'll want to wear the emblem, rosette, or bar on fitting occasions, and display the plaque and membership certificate in your home or office. Insignia are in the attractive ordnance colors—maroon and gold.

Indicate your preference below and return this form with your check to Association headquarters. Postage is prepaid to domestic destinations.

	Quantity Desired	*Amount*
Lapel Emblem (bronze), $1.50	. . . . .	. . . . .
Lapel Bar (bronze), $1.00	. . . . .	. . . . .
Ribbon Lapel Rosette, $1.00	. . . . .	. . . . .
The Medal (bronze), $2.50	. . . . .	. . . . .
Wall Plaque (8"x9"), $3.00	. . . . .	. . . . .
Bar Ribbon, 50¢	. . . . .	. . . . .
Ribbon (1½"), $2.00 a yard	. . . . .	. . . . .
Lapel Ribbon (¼"), $1.50 a yard ($0¢ ¼-yard)	. . . . .	. . . . .
Membership Certificate, $1.50	. . . . .	. . . . .
Cigarette Lighter, $5.00	. . . . .	. . . . .
Tie Chain, $5.00	. . . . .	. . . . .

Federal Tax included in prices

☆ ☆ ☆

Return to: AMERICAN ORDNANCE ASSOCIATION
708 Mills Building, Washington 6, D.C.

Please send me insignia as indicated above. My check for $..... is enclosed. Mail to:

Name of member .....

Street Address .....

City..... Zone.... State.....

Communications

ejectors, and feed mechanisms are considered, it would be cheaper and quicker to make new weapons in the first place. It is desirable that we change cartridges, and now is as good a time as we are likely to find in years to come.

As for the weapons themselves, who can deny that we definitely need new and different light machine guns, rifles, and submachine guns? Our light machine gun dates from 1919, and to be sure it is thoroughly reliable. However it is outclassed by the Russian and German light machine guns.

The light weight of these guns and the quick barrel change and ability to fire from magazine, drum, or belt bring them into a class of their own. It would not be difficult to make a weapon to fire the T65 cartridge that did not weigh over twenty-five pounds with quick barrel change and that would fire from belt, magazine, or drum at will. Firing from either an open or closed bolt would make this ideal.

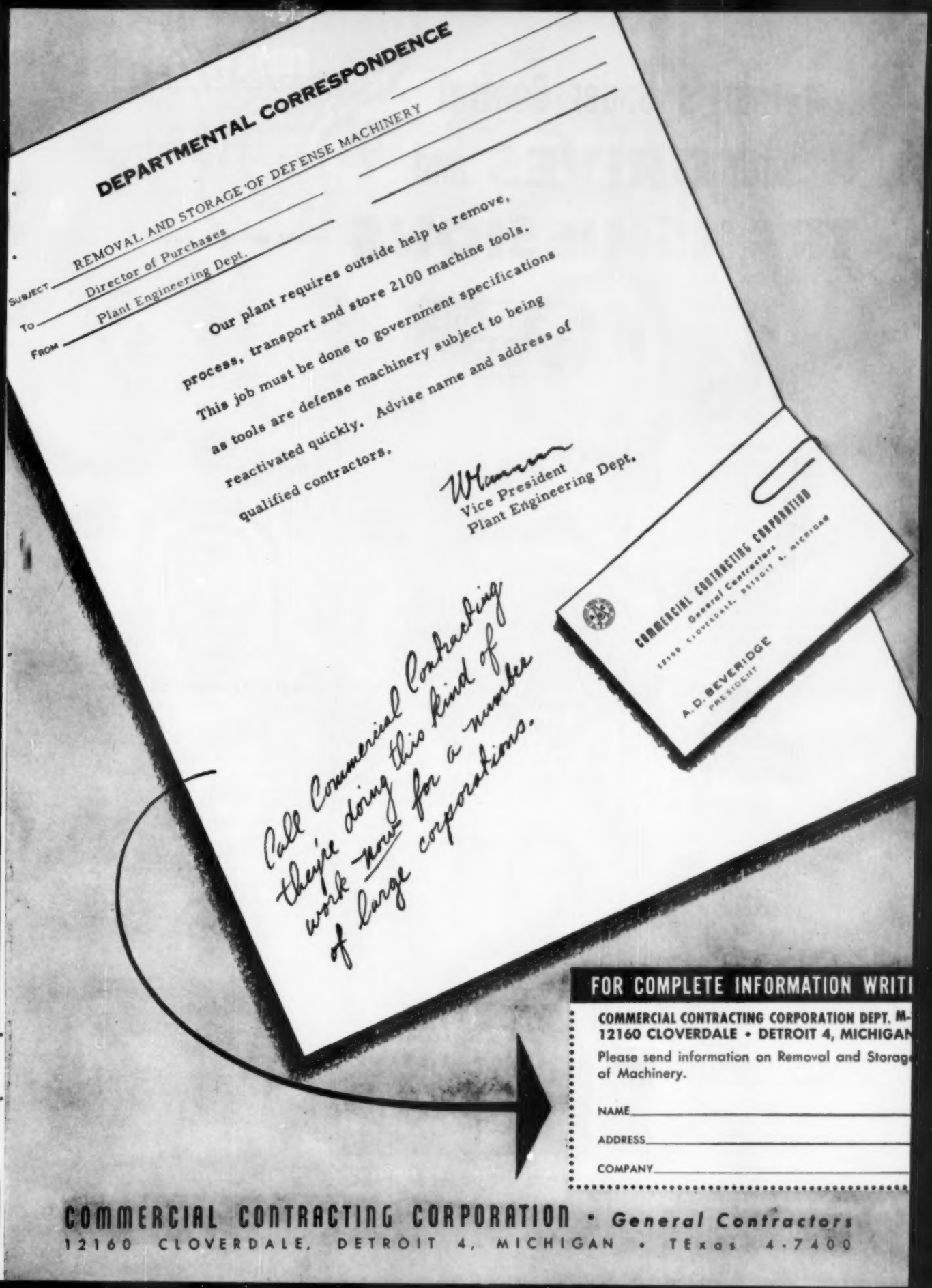
Next, let us consider the submachine gun. The huge .45 cartridge that we use in our pistols and submachine guns causes these guns to be large, heavy, and rather unpopular. We must admit that there is not another military cartridge of this class in the world that has more plain knockdown power than our .45 auto cartridge. Eventually, I suspect, we will reduce our caliber to 9-mm. or to .38, but that is wishful thinking at present, I am afraid.

I have always felt that a weapon with a 14-inch barrel of 9-mm. Luger caliber firing from a closed bolt either full or semiautomatically would be ideal for a great many purposes. If this gun had a folding stock like the German machine pistol Model 40 and magazine in 10-, 30-, and 75-round size it could be used for service as well as airborne troops. It needn't weigh over six pounds, and stampings could predominate.

The infantry rifle is the only one of these weapons that is now in the process of undergoing a major operation. This is as it should be as the rifle is the chief weapon of the Queen of Battle in the U.S. Army.

The most consideration should go into selecting the weapon to replace the Garand (M1) rifle. As a whole there isn't a finer semiauto rifle in the world today.

The main competitor to the modernized version of the Garand is the Belgian-made FN. This was developed from the German MP/43 (you may know it as SG/44 or MKb/42), and while it has excellent engineering features it is not in a class with American weapon ideas. I wonder if the weight of the new version of the Garand could not be reduced below the present eight pounds, ten ounces?


DEPARTMENTAL CORRESPONDENCE
SUBJECT REMOVAL AND STORAGE OF DEFENSE MACHINERY
TO Director of Purchases
FROM Plant Engineering Dept.
Our plant requires outside help to remove, process, transport and store 2100 machine tools. This job must be done to government specifications as tools are defense machinery subject to being reactivated quickly. Advise name and address of qualified contractors.
Vice President
Plant Engineering Dept.
COMMERCIAL CONTRACTING CORPORATION
General Contractors
12160 CLOVERDALE, DETROIT 4, MICHIGAN
A.D. BEVERIDGE
PRESIDENT
Call Commercial Contracting they're doing this kind of work now for a number of large corporations.
FOR COMPLETE INFORMATION WRITE
COMMERCIAL CONTRACTING CORPORATION DEPT. M-
12160 CLOVERDALE • DETROIT 4, MICHIGAN
Please send information on Removal and Storage of Machinery.
NAME
ADDRESS
COMPANY
COMMERCIAL CONTRACTING CORPORATION • General Contractors
12160 CLOVERDALE, DETROIT 4, MICHIGAN • TExas 4-7400

Everything's Under Control with DRIVES and TRANSMISSIONS

by BREEZE MARK

90° ACTUATOR DRIVE
For direct connection to actuator that pivots in trunion mounting

TORQUE TUBE DRIVE
For transmitting torque between torque tube and flexible shaft

90° DRIVE
Precision gearing, double ball bearing suspension Sealed and lubricated

TEE DRIVE
Precision geared for actuators connected in series

▪ To actuate tabs, flaps, shutters and other aircraft mechanisms with positive, precision control, the industry long has relied on Breeze drives and transmissions. From simple mechanical drives and direct reading indicator drives to electrical and hydraulic actuators, Breeze offers a complete line, affording a wide choice of components and assemblies to meet many individual design needs.

Shown here are examples of Breeze-engineered lightweight mechanical drives, having connections to mate with flexible shaft drives. The 90° and TEE drives may be mounted in any position with relation to an actuator mounting.

Inherent in all these designs are features dictated by specific aircraft needs and experience. You may find the assemblies you require in our wide variety, thus saving design and tooling costs. Or, our engineers will design and custom build to your special requirements.

We invite consultation. Write for our complete informative catalog.

OTHER BREEZE PRECISION PRODUCTS

Special Electrical Connectors
Electro-Mechanical and Hydraulic Actuators
Ignition Shielding
All Types of Flexible Metal Tubing
Aero-Seal Worm Drive Hose Clamps

BREEZE CORPORATIONS, INC.
700 Liberty Avenue, Union, New Jersey

Communications

I think you will agree with me that it is a hopeless task to attempt to combine all these features into one weapon and to use it effectively in these days of specialization. Let us not carry it to folly.

RICH. LAUCHLI

Collinsville, Ill.

"SOUL IS STILL THERE"

THE EDITORS.—The article, "Has the Army Lost Its Soul?" by Maj. George Fielding Eliot published some time ago in ORDNANCE was most timely—even though it may fail to rescue our fighting forces from the vicious disintegration methods sponsored by bureaucratic iconoclasts in Washington.

As a Yankee serving in two wars with Canadians I have experienced the elan and dedication of British and Canadian fighting units with tradition behind them.

I have circulated the article in question through a cross section of the forces on this base and find that a soul is there still smoldering—needing only a change back to the regimental basic unit of Army organization to fan into fire the devotion to traditional achievement.

If tear copies or reprints of the article are available a few copies would be welcomed as there have been many requests for a loan of the issue of ORDNANCE in which the article appeared.

W. E. MANHARD

A.P.O., Seattle, Wash.

MECHANIZATION VS. COST

THE EDITORS.—Garrett Underhill's comments on mechanization of modern armies in the March-April issue of ORDNANCE are instructive and more or less verified by recent evolution of military tactics. However, grave logistics problems accompany excessive mechanization.

A single tank gulps enormous amounts of munitions and fuel, and an armored division represents an array of strategic materials, production effort, supply, rear-echelon organization, technological maintenance, and costs that are literally staggering considering the amount of manpower and equipment directly involved.

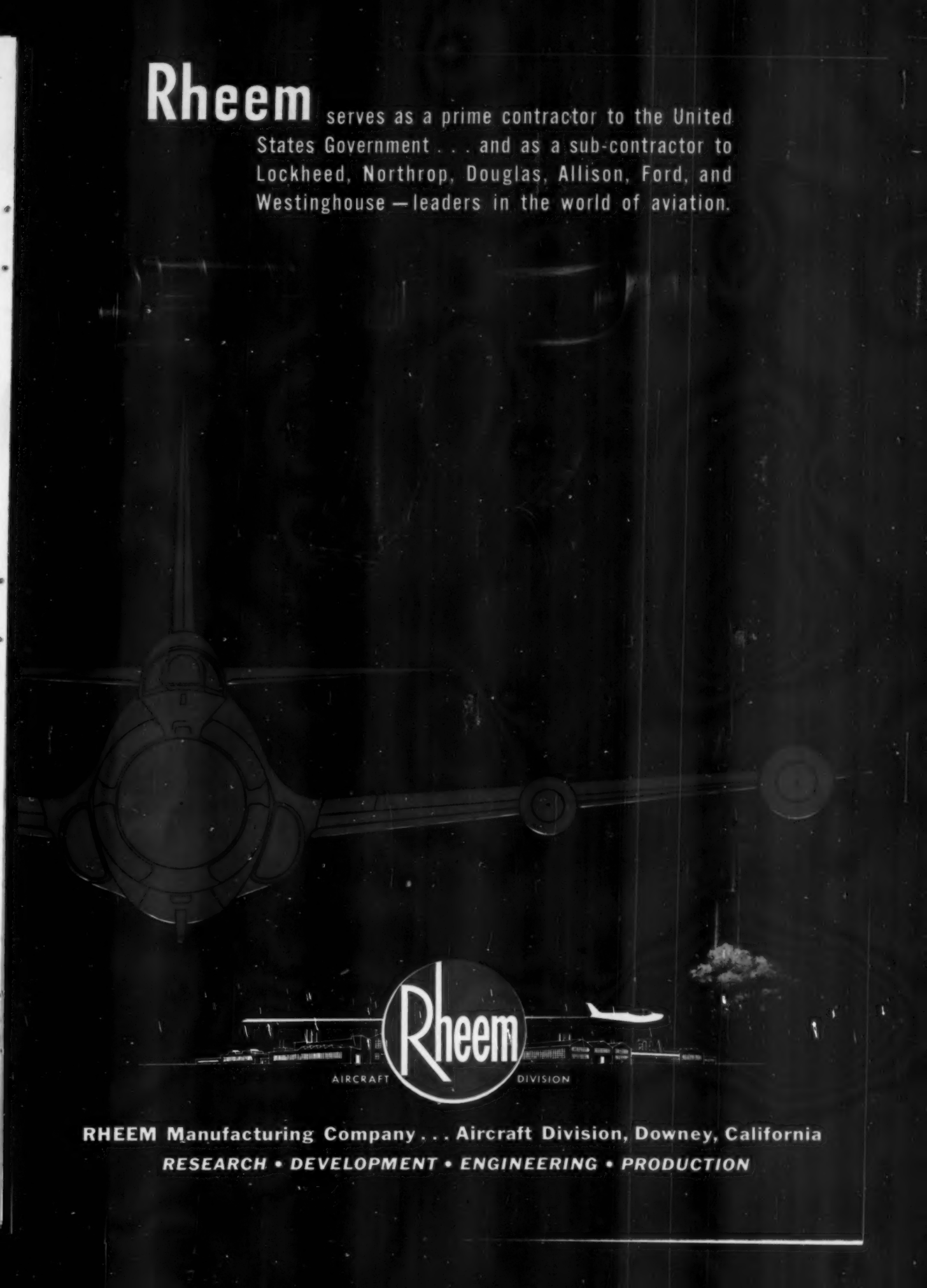
If we attempt to mechanize a major portion of our land arm, who is to pay the astronomical bill and how are we to lick the rapid obsolescence problem long before any major military effort is required? The problem is vast and complex, and an intense effort at armoring whole armies does not appear to be the solution.

The big problem seems to be just where best to draw the line of balance between costs, military security, and flexibility. This may be something of a nut to crack, with the advent of nuclear weapons not making things any simpler.

TED POWELL

Great Neck, N. Y.

Rheem serves as a prime contractor to the United States Government . . . and as a sub-contractor to Lockheed, Northrop, Douglas, Allison, Ford, and Westinghouse — leaders in the world of aviation.

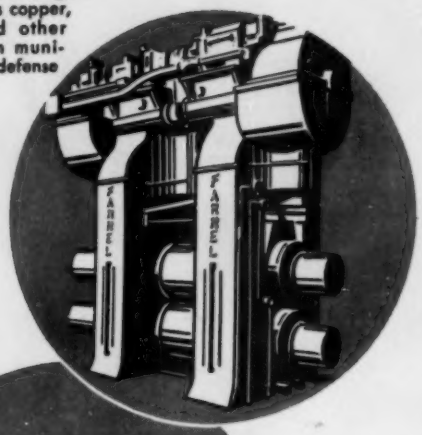


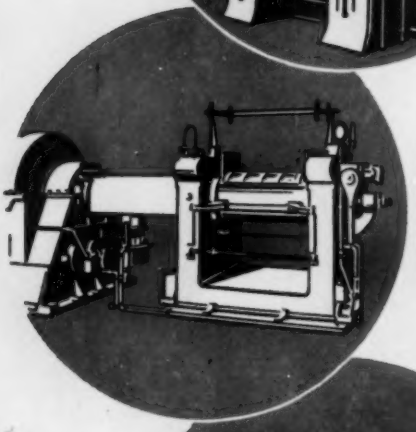
RHEEM Manufacturing Company . . . Aircraft Division, Downey, California

RESEARCH • DEVELOPMENT • ENGINEERING • PRODUCTION

3 typical examples of Farrel® *DEFENSE* engineering

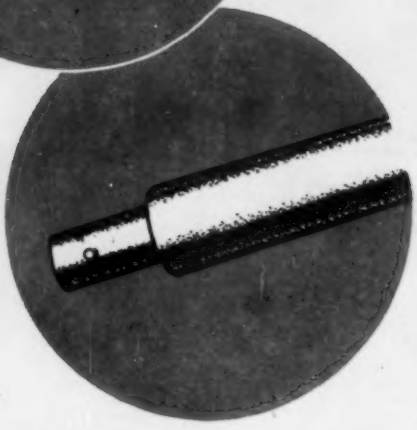
Mills for rolling cartridge brass, as well as copper, aluminum and other metals used in munitions and other defense supplies.





Roll mills and calenders for the manufacture of explosive powder.

Molds for the centrifugal casting of gun barrels of 3-inch, 75-mm, 90-mm, 105-mm and other calibers.



These are only a few of the many diverse products designed and manufactured by Farrel for defense plants. For further details send for a copy of Bulletin No. 55B.

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONNECTICUT
Plants: Ansonia and Derby, Conn., Buffalo, N. Y.

FB-903

Farrel-Birmingham®

FROM THE RECORD

TIME FOR RESEARCH

Donald A. Quarles
Assistant Secretary of Defense for Research and Development

I AM not at all certain that the public understands the extent of the effort necessary to develop and maintain a complex military system such as the Strategic Air Command or the air-defense system. The B-52 and B-47 strategic bombers and the Nike missiles are just individual pawns in this gigantic chess game. Yet each requires years for the process from research and development through to operational capability. It is not a process that can begin in August and be finished in December.

Let us look at the Nike development, for example. It was 1945 when the Army first asked Bell Telephone Laboratories for a paper study of the problems involving in developing an antiaircraft system adequate to counter the speedy, maneuverable, high-speed aircraft then in existence and on the drawing boards. The study was followed by a development contract, and the Douglas Aircraft Company became a full partner with responsibility for the design of the missile itself and the launching-system equipment.

Nearly five years were required to solve the technical design and production problems posed by the Nike system. Although missile firings without guidance control were started in 1946, successful test firings of the controlled missile as a system were undertaken only two years ago. . . .

Our other major weapons follow this same pattern. It is inherent in the development of the complex systems coming from our advanced science and technology. Due to the nature of our technology and the threat facing us, we must have a strong, continuous research and development program. I feel that with our reorganization in the Department and with steady, continuous support for research and development, we can achieve our objectives.—*From an address before the National Security Commission of the American Legion.*

COST OF ATOMIC ENERGY

Lewis L. Strauss
Chairman, U.S. Atomic Energy Commission

SINCE the end of World War II it can be asserted that whatever the atom has taken out of the American economy has been in great measure due to the policies of the Soviet Union. President Eisenhower described the result of these policies in his speech of April 1953 when he said the Communists sought their security by denying security to all others. He added:

"The amassing of Soviet power alerted free nations to new danger of aggression. It compelled them in self-defense to spend unprecedented money and energy for armaments. This has been the way of life forged by eight years of fear and force."

The United States has had to bear the major portion of the cost. The atom's share in this postwar period has been around $11 billion. This figure does not include the budget bill now pending in Congress. It is the approximate total appropriated for the Commission since it took over from the Corps of Engineers in 1947 through the last fiscal year.

The greater part of this money has been used to buy uranium ore, to build and operate plants and laboratories, to manufacture and test weapons, and to support fundamental research.

Our operating costs are at the billion-a-year mark although

Bendix power

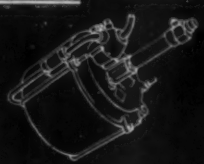
STEERING AND BRAKING

Makes Truck Operations Easier, Safer, More Economical

Today's most wanted power features for cars and trucks

Bendix* POWER steering

Here is an efficient, easy to install power steering unit that simplifies production line installation. Because Bendix Power Steering is of the linkage type, it may be adapted to any manufacturer's model without extensive engineering changes in present steering designs. Meet the increasing demand for power steering more efficiently and more economically with Bendix Power Steering.



Bendix HYDROVAC* POWER brake

With over four million in use, the Bendix Hydrovac is by all odds the world's most widely used power brake for commercial vehicles. This overwhelming preference for Hydrovac is a result of sound engineering design, exceptional performance, low original cost and minimum service upkeep. Make the industry's choice your choice, specify Hydrovac for all your commercial vehicles.

Bendix AIR-PAK* POWER brake

With one simple compact unit, Bendix Air-Pak combines all of the well-proven advantages of hydraulic brake actuation with an air brake system. An important advantage of Air-Pak is that brakes can be applied by foot power alone when braking is required before air pressure builds up or if it should fail for any reason. For faster, better controlled air-hydraulic power braking, specify Air-Pak.

Truck operators know from actual experience based on millions of installations that Hydrovac and Air-Pak are the undisputed leaders in their fields of power braking. And—more and more truck manufacturers and truck operators are discovering the outstanding efficiency and economy of Bendix Power Steering.

Yes—"Bendix Power," whether measured in terms of individual power devices or considered in terms of unmatched engineering and manufacturing facilities, makes truck operations easier, safer and more economical.

*REG. U.S. PAT. OFF.

Bendix Products Division

BENDIX PRODUCTS DIVISION SOUTH BEND INDIANA

Bendix AVIATION CORPORATION

Export Sales: Bendix International Div., 205 E. 42nd Street, New York 17, N. Y.

we are exerting every effort to keep the expense of operation and administration at the lowest levels consistent with efficiency and security. However, when facilities currently under construction begin to operate and the expected increases in the production of raw materials are realized, this annual figure may be twice its present level. Thus the necessity for utilizing the military potential of the atom has contributed to the heavy tax burden the American people have had to bear in the postwar years.

Do not infer from this that the sum spent on atomic energy is lost, as is the case with most other expenditures. It is true the taxpayer has put up $11 billion thus far, but the American people now own a vast industrial complex which, at today's replacement value, is probably worth in excess of its original cost.

The major product which has been produced, that is to say the fissionable material in atomic weapons, can be just as well used for power, if it is ever safe to do so—safe, that is, in the international political sense. It is not perishable.

Viewed in this light, therefore, we have used our $11 billion to build a capital plant and to stockpile uranium-235, plutonium, and other special materials as enormous reserves which may ultimately return their cost to us—perhaps far more than that—in the production of economical electrical energy.

It would be misleading to assume that the atomic-energy program involves a cost represented by the expenditure of money alone. It is the demands of this program for electricity, for critical materials, and for highly trained and specialized manpower that have had the greatest impact on the economy of our country by taking material and men out of other pursuits.

When all our facilities are in operation, it appears that our atomic program will be using up to ten per cent of all the electricity made in the United States. It already uses more than seven per cent of all the nickel production and twenty per cent of the stainless-steel tubing, to mention but a few items.—*From an address before the Brand Names Foundation, New York, N. Y.*

RESERVOIR OF TECHNOLOGY

Henry B. du Pont

Vice-president, E. I. du Pont de Nemours & Company

EVERY one knows that modern warfare is as dependent upon technology as it is upon human performance, and that a corps of scientifically trained people is as vital as a corps of artillery or an Air Force wing. What is not so obvious, perhaps, is that both technology and technical manpower are dependent upon industrial opportunities . . .

American industry today is the principal reservoir of this indispensable pool of talent. In production technology, as distinct from the purely scientific, it stands alone. In the field of reseach, there are, of course, many very able people in the universities who form the hard core of scientific thought. Important research in this country is also being done by or financed by various government bodies.

But the American industrial establishment has become so research-conscious in recent years that it is now the largest employer of scientific personnel. The professional research staffs of private industrial laboratories now number over 70,000 persons, and it is estimated they will exceed 135,000 in 1956. The research budget of American industry now approaches $1 billion a year.—*From an address before the Virginia State Chamber of Commerce, Richmond, Va.*

pip
SELF-LOCKING QUICK-RELEASE PINS
...the "Inside Story" for
SOLVING EVERY IMPORTANT LOCKPIN PROBLEM!
"SIMPLE — no cotter pins, nuts, bolts or other separate retaining items or assembly tools required!"
"ECONOMICAL — and available in most standard bolt diameters and lengths or to individual specifications — and in single-action types, too!"
"PATENTED — push-to-insert, pull-to-remove principle is trouble-free and dependable!"
"VERSATILE — for all types of clevis, tube joint and bracket assemblies in blind or open applications!"
"FAST — PIP pins speed up assembly with positive quick-release and self-locking safety!"
PIP'S PATENTED FEATURES APPROVED BY LEADING ENGINEERS!
The patented push-to-insert, pull-to-remove principle of PIP double-acting pins provides quick release and positive self-locking safety in a single unit. Time-proven performance and engineering approval have made PIP pins an accepted part in industrial, military and aircraft designs!
Write for complete details — TODAY!
AVIATION DEVELOPMENTS INC.
PIP
210 NORTH FRONT STREET • BURBANK, CALIFORNIA
AVIATION DEVELOPMENTS (CANADA), LTD., TORONTO • AVIATION DEVELOPMENTS, LTD., LONDON, ENGLAND

You're Going Around in the Best of O's

when you come to Wolverine for

Projectile Rotating Bands...

Yes, you'll be going around in the best of circles if you'll stamp Wolverine as your "first choice" supplier of tubular products for ordnance.

That's because of Wolverine's extensive experience in meeting—sometimes even bettering—rigid governmental specifications. Proof of the pudding lies in the fact that Wolverine has produced many millions of copper and gilding metal rotating bands as well as an untold number of electric-welded steel primer tubes.

Experience, quality control, trained technicians and top-flight equipment all add up to Tubemanship—your guarantee of satisfaction.

Remember, Wolverine products are made in three metals: copper (and its alloys), aluminum, and electric-welded steel. You'll have full information at your finger tips if you write for Wolverine's handy Statement of Scope—*right now!* Wolverine Tube Division of Calumet & Hecla, Inc., 1499 Central Avenue, Detroit 9, Michigan.

Don't forget: Wolverine can produce larger rotating bands—including 75 mm, 76 mm, 90 mm and 105 mm.

EST. 1916

WOLVERINE TUBE DIVISION
OF CALUMET & HECLA, INC.
Manufacturers of Quality-Controlled Tubing

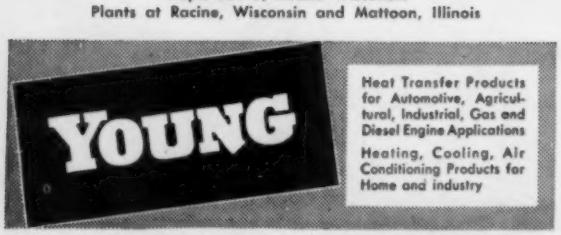
PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES.
EXPORT DEPT., 11 E. 48TH ST., NEW YORK 18, NEW YORK

YOUNG
HEAT TRANSFER UNITS FOR MILITARY REQUIREMENTS

Mobile Compressor Cooling
Portable Generator Cooling
Young-built aftercooler for two-stage compressor
Young Welded steel tank and side member radiator for U. S. Navy
Young "Mono-Weld" radiator for heavy-duty use on trucks and mobile equipment
Young fixed or removable tube and bundle heat exchangers offer maximum heat transfer per pound of weight.
Jet Plane Heat Transfer
Industrial Engine Cooling
Transport Truck Cooling
Crash Truck Cooling
Many Young-engineered products are serving the defense effort—helping prime contractors produce equipment that withstands the roughest military usage. We can help you solve your cooling problem.

YOUNG RADIATOR COMPANY

Dept. 184-G, Racine Wisconsin
Plants at Racine, Wisconsin and Mattoon, Illinois


YOUNG
Heat Transfer Products for Automotive, Agricultural, Industrial, Gas and Diesel Engine Applications
Heating, Cooling, Air Conditioning Products for Home and industry

Leaders in Heat Transfer Engineering for more than 25 years

Book REVIEWS

Review Staff

BRIG. GEN. DONALD ARMSTRONG, *military historian, lecturer, author, Washington, D. C.*

COL. JOHN D. BILLINGSLEY, *educator, ordnance authority, author, United States Military Academy, West Point, N. Y.*

COL. GEORGE S. BRADY, *consulting engineer, author, editor, Washington, D. C.*

COL. JOHN J. DRISCOLL, *author, air armament engineer, air combat officer, NATO, Paris, France.*

F. W. FOSTER GLEASON, *military historian, ordnance analyst, editor, Washington, D. C.*

COL. CALVIN GODDARD, *small-arms authority, military historian, author, Washington, D. C.*

COMDR. R. E. JEFFERY, *educator, ordnance expert, United States Naval Academy, Annapolis, Md.*

LIEUT. COL. MELVIN M. JOHNSON, JR., *automatic arms expert, inventor, author, New Haven, Conn.*

DR. ARTHUR F. MACCONOCHIE, *educator, mechanical engineer, ordnance authority, University of Virginia, Charlottesville, Va.*

BRIG. GEN. EDWARD P. MECHLING, *air armament engineer, administrator, author, Eglin Air Force Base, Fla.*

COMDR. JOHN V. NOEL, JR., *engineer, author, executive officer,* U.S.S. ROCHESTER.

DR. JOHN J. O'CONNOR, *educator, author, editor, Washington, D. C.*

COL. PHILIP SCHWARTZ, *author, ordnance expert, Pasadena, Calif.*

LIEUT. COL. S. M. SMOLENSKY, *engineer, Ordnance officer, Belgrade, Yugoslavia.*

BRIG. GEN. THOMAS K. VINCENT, *artillerist, engineer, author, Redstone Arsenal, Huntsville, Ala.*

From the Danube to the Yalu. By Mark W. Clark. New York: Harper & Brothers. 363 pp. $5.

HERE General Clark gives a blow-by-blow account of the Korean negotiations leading up to the armistice. He first sets the stage by establishing his background in negotiation with the Russians as American High Commissioner for Austria and at conferences in London and Moscow. Based upon these experiences he draws a direct comparison between Russian and Chinese tactics and concludes that both will respect nothing but force.

Added to this experience was that gained by General Clark as Chief of Army Field Forces which provided him with a personal knowledge of military training that aided in the expansion and development of the Republic of Korea forces during the period of negotiations.

The first major problem confronting General Clark when he succeeded General Ridgway as Supreme Commander of the United Nations forces was the prisoner of war situation at Koje and elsewhere. Considerable space is devoted to the inside story of the rebellion in the compounds and of the well-organized "sixth-column" conspiracy within the camps. The contrast between the Allied treatment of prisoners of war and the treatment received at the hands of the Communist captors by Allied personnel as revealed by testimony of released prisoners is vividly set forth. The problems involved first in "Little Switch," the exchange of sick and wounded, and later "Big Switch" are

Where's "Charlie"?

The "bird" will find him!

As it rockets along at supersonic speeds—high above the earth—its guidance system directs it unerringly to target "Charlie."

Electronics makes today's accurate missile guidance a reality—and *electronics* is the past, present and future of RCA.

For years, RCA has been working with the Armed Forces on design and engineering of more accurate, more effective missile-guidance systems. The same RCA engineering facilities—from original planning to final production stages—are available for development of complete electronic systems of all kinds. For additional information, write to Government Department, Engineering Products Division, Radio Corporation of America, Camden, N. J.

GOVERNMENT DEPARTMENT

RCA **RADIO CORPORATION of AMERICA**

ENGINEERING PRODUCTS DIVISION CAMDEN, N.J.

frankly presented and clearly discussed.

The failure of the United Nations to secure a military victory in the early days of Chinese participation is attributed to unwillingness to risk World War III by all-out military effort. This risk is minimized by the author. The point is strongly made that the Chinese entered the conflict with only numerical superiority in their favor and that they have now, through lessons taught by our own forces, an efficient, well-trained fighting army with adequate supporting forces.

Undoubtedly this book will arouse a storm of discussion and controversy. General Clark speaks for those Americans who deplore "soft" handling of Communism and feel that peace will come to us only if we are strong, if the Russians and their followers know we are strong, and if they are convinced we have the determination and courage to use that strength both politically and militarily to achieve victory.—JOHN D. BILLINGSLEY.

The Undeclared War, 1940-1941. By William L. Langer and S. Everett Gleason. New York: Harper & Brothers. 963 pp. $10.

THIS history covers World War II from September 1940 when Japan signed the Tripartite Pact with Hitler and Mussolini to the Japanese attack on Pearl Harbor in December 1941.

The history is centered on the foreign policy of the United States including objectives, plans, and activities. However, since these were dependent on the efforts of the other participants, all the nations involved are treated in like manner. It thus gives a blow-by-blow description of the moves—political, military, economic, and psychological—made by the various contestants in the most devastating, worldwide, and complex international struggle that has ever gripped the human race.

The book describes how Hitler, after the Battle of Britain, turned his efforts to the battles of the Atlantic, the Mediterranean, the Balkans, the Middle-East, and, finally, Russia. His great objective was to win these battles before the might of America could be mobilized and successfully deployed against him. Nor did he overlook the Pacific, for it was to control this area through his ally, Japan, that the Tripartite Pact was signed. He hoped that Japan would force Russia and Britain and especially the United States to prepare for and fight a major Pacific war with obvious advantages to himself.

"The Undeclared War" indicates that Japan's efforts were directed toward the establishment of the East Asia Co-Prosperity Sphere with her control of that vast territory—by diplomacy if possible but, if not, by a war that could be fought and won before America could be mobilized to defeat her.

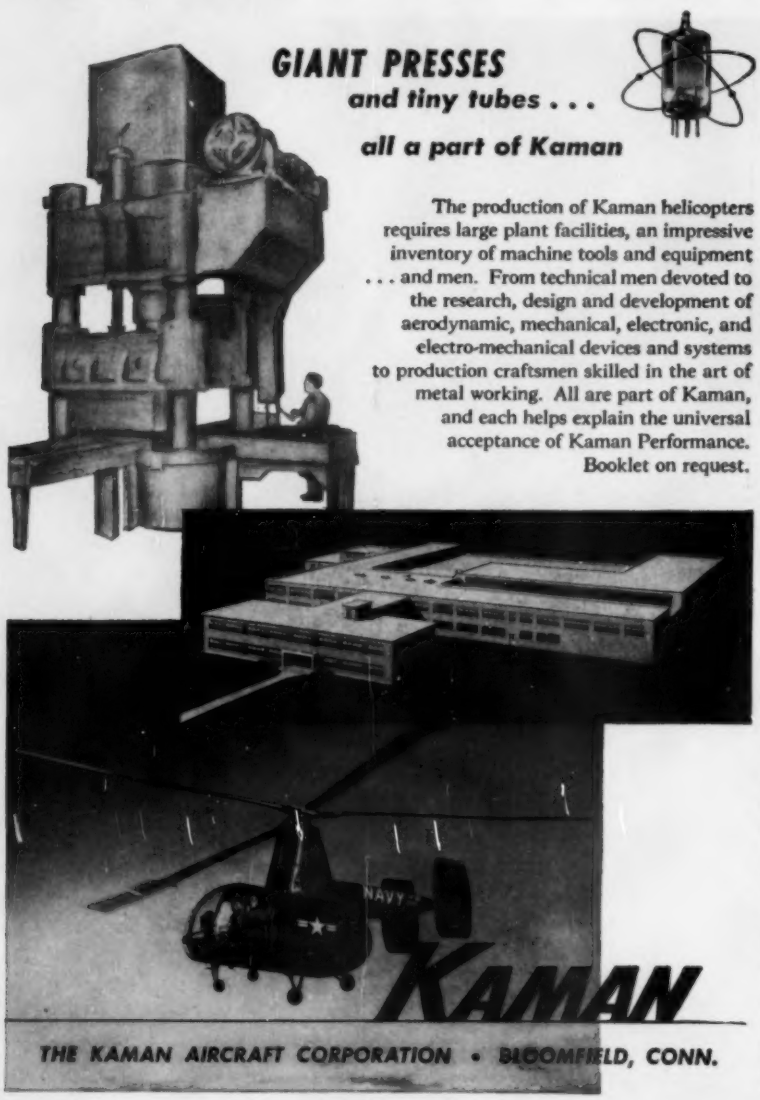
At the same time, America's efforts were aimed at thwarting those of the two major aggressor nations by denying them raw materials, by helping the countries arrayed against them through all means short of war, by influencing nonparticipants to remain on our side through the use of economic and other forces, by mobilizing our own strength for the war effort if that became necessary but by making every reasonable effort to postpone hostilities as long as possible and certainly until adequate military strength could be mobilized.

It is interesting to note that then as now public opinion was divided and that decisions and actions, prior to Pearl Harbor, were slow and difficult.—J. H. BURNS, *Major General, U.S. Army, Retired.*

Secretary Stimson—A Study in Statecraft. By Richard N. Current. New Brunswick: Rutgers University Press. 272 pp. $4.50.

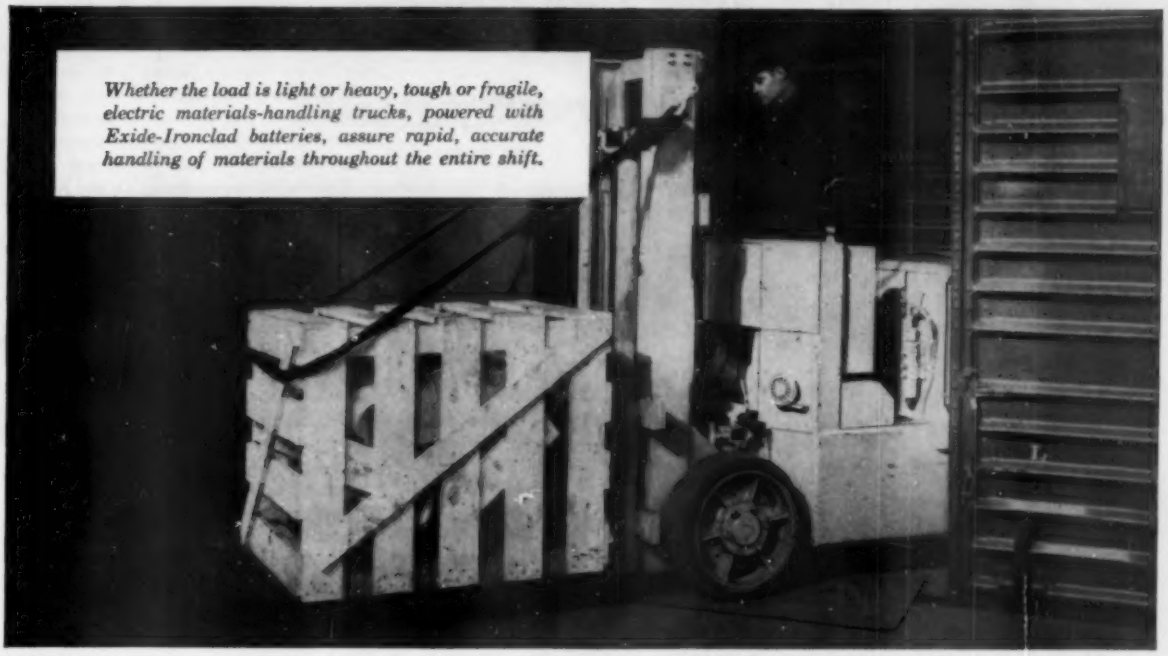
PROFESSOR Current, the author of this character study, teaches history at the University of Illinois. He began his researches of the subject matter of his book in 1949. He has made extensive use of the manuscript diaries of Secretary Stimson and of William R. Castle, a former Under Secretary of State, and of the hearings of the Army Pearl Harbor Board and the Joint Congressional Committee investigating the Pearl Harbor attack.

Secretary Stimson, of whom Professor Current writes objectively and in the cold light of the record, was a statesman of renown, holding high office under seven presidents of the United States.


GIANT PRESSES
and tiny tubes . . .
all a part of Kaman
The production of Kaman helicopters requires large plant facilities, an impressive inventory of machine tools and equipment . . . and men. From technical men devoted to the research, design and development of aerodynamic, mechanical, electronic, and electro-mechanical devices and systems to production craftsmen skilled in the art of metal working. All are part of Kaman, and each helps explain the universal acceptance of Kaman Performance.
Booklet on request.
NAVY
KAMAN
THE KAMAN AIRCRAFT CORPORATION • BLOOMFIELD, CONN.

GET FULL SHIFT HANDLING, NO UNSCHEDULED DOWN TIME

... with low cost Exide-Ironclad power!



Whether the load is light or heavy, tough or fragile, electric materials-handling trucks, powered with Exide-Ironclad batteries, assure rapid, accurate handling of materials throughout the entire shift.

YOU GET uniform performance throughout each shift when battery electric trucks are powered by Exide-Ironclads. Your trucks handle as much load during the last hour as during the first . . . with no unscheduled down time. Lower costs for operation, maintenance and depreciation make Exide-Ironclads your best power buy—AT ANY PRICE!

THE POSITIVE PLATES are the heart of any battery. Only Exide uses a slotted tube construction. By use of tubes, more active material is exposed to the electrolyte, providing *greater power*. Also, more active material is retained, giving *longer working life.*

THE NEW THRIFTY HAULER! The improved industrial truck battery. *Non-oxidizing* plastic power tubes assure longer battery life, more capacity in the same space. For full details, call your Exide sales engineer—write for Form 1982 (Installation and Maintenance of Motive Power).

Your best power buy ... AT ANY PRICE!

Exide®

IRONCLAD® BATTERIES

Exide INDUSTRIAL DIVISION, The Electric Storage Battery Company, Philadelphia 2, Pa. • *Exide Batteries of Canada, Limited, Toronto*

And, incidentally, Secretary Stimson also served as counsel of the Army Ordnance Association during the 1920's!

Such unique public service placed the subject in many controversial situations over a long and active life. Only now in the perspective of hindsight can one begin to appraise the wisdom of his policies and the error of them. But none can gainsay, as Professor Current demonstrates, the sincerity of the motive.

Sincerity of motive is not enough, however, in public as well as private conduct. Take for example the Stimson decision to use the atomic bomb on Hiroshima and Nagasaki. He defended that decision on the untenable moral grounds that the end justified the means; namely, that by killing thousands of enemy noncombatants he would save the lives of thousands of American soldiers.

Further, even had the bombs been used against strictly military targets their use at that stage of the conflict would have been unwarranted because, as the Strategic Bombing Survey reported, "certainly prior to December 31, 1945, Japan would have surrendered even if the atomic bombs had not been dropped, even if Russia had not entered the war, and even if no invasion had been planned or contemplated."

So the surprise value of the world's mightiest weapon was wasted! But on this score no less a personage than Gen. George C. Marshall stressed the "shock value" of the new weapon!

Professor Current has given his book the subtitle—"The First Assessment of a Controversial Career." And well he might.—LEO A. CODD.

A History of the Southern Confederacy. By Clement Eaton. New York: Macmillan Company. 351 pp. $5.50.

THE author, a professor of history at the University of North Carolina, has achieved a compendium which is unusually striking in its successful presentation of an over-all picture of the Southern Government and people.

While neglecting neither the military nor the political aspects of a nation that was born, spent its entire life, and died in conflict, he yet concentrates on the cultural and economic aspects. For this he has relied heavily upon the letters and diaries of undistinguished folk; usually more candid than those of leading soldiers and citizens.

Dr. Eaton gives an excellent evaluation and summary of the causes and the beginning of the struggle. He terms it "The Conservative Revolt" and attributes a far greater share to cultural fears and differences than to the more commonly used explanations of "loss of political power" and "an agricultural versus an industrial economy."

In his treatment of the Civil War itself, Eaton does well; his grading of individual military leaders and his evaluation of strategy, campaigns, and weaknesses is quite sound. Perhaps his best contribution to the military picture is his thought that the greatest strategic error of the Confederacy was its failure to strike at once with all its force, and to invade the North in the first year of the war.

This he blames primarily on the Southern President, Jefferson Davis, who was preoccupied in affording complete defense to all localities and every mile of frontier.

Indeed, he comes very close to convincing proof that Davis' stubbornness and his blindness when irritated rates extremely high among the causes for Confederate defeat, coupled, of course, with excessive "constitutionalism" and "civil liberties" as exemplified by Alexander Stephens and Governors Brown of Georgia and Vance of North Carolina.

Eaton's notes on ordnance and logistics are far more copious and penetrating than is usually found in a Civil War general history of this size. So also is his coverage of naval and river-gunboat matériel and fighting.

The monetary end of Confederate eco-

WE BELIEVE THAT A STRONG AMERICA IS A PEACEFUL AMERICA

MASON & HANGER COMPANY

SILAS MASON COMPANY

ENGINEERS

and

CONTRACTORS

Builders and Operators of

Ordnance Facilities

OFFICES:

500 Fifth Avenue
New York

Shreveport
Louisiana

Lexington
Kentucky

EXPERIENCE

Launching Point for Missile Development

Ever since 1946, when the Navy flew this nation's first surface-to-air guided missile, Fairchild has been contributing to the advancement of missile design and development. Fairchild built that precedent-breaking missile.

The experience gained has been broadened incalculably by the variety of missiles produced for *all* the Armed Services.

Today at Fairchild an integrated engineering team — adept in electronics, air frame structure and aerodynamics, propulsion and in the design of missile ground equipment — is applying the specialized knowledge that only years of experience can bring to a number of current missile projects.

ENGINE AND AIRPLANE CORPORATION

FAIRCHILD

Guided Missiles Division

WYANDANCH, N. Y.

Aircraft Division, Hagerstown, Maryland • Engine Division, Farmingdale, N. Y.
Speed Control Division, Wickliffe, Ohio • Stratos Division, Bay Shore, N. Y.
American Helicopter Division, Manhattan Beach, Calif.

nomics is well handled. As this was doubtless a heavy factor in Southern difficulties and final collapse, it will prove a valuable point for any student. Especially is this true of the misguided "cotton famine" policy of the administration. The journal of Brig. Gen. Josiah Gorgas is much quoted in this connection.

This volume should appeal to a wide variety of readers, and it especially offers the student much that is missing save in much larger or more specialized works.—F. W. Foster Gleason.

Lead in Modern Industry. New York: Lead Industries Association. 230 pp. $1.50.

THIS little book has been prepared by the Lead Industries Association with the idea of assembling in one volume the technical data on lead and its compounds that may be useful to engineers, designers, metallurgists, and industrialists who use the metal or products derived from it. There is scarcely any manufacturing industry that does not employ this plentiful and versatile metal in some form.

The various types of lead and their methods of production and application are described. Chapters are devoted to the use of lead in the chemical industries, in plumbing, in architecture, in radiation protection, and in bearing metals, and well-selected illustrations show methods of application.

Considerable space is given to data on lead pigments, tetraethyl lead, and the important lead chemicals. Useful tables have been gathered and dispersed in the book that cover the physical, chemical, and other properties of the metal and the compounds. No factory library should be without this book.—George S. Brady.

Bull Run Remembers. By Joseph Mills Hanson. Manassas, Va.: National Capitol Publishers, Inc. 194 pp. $1.90 paperbound, $2.75 clothbound.

ALTHOUGH Major Hanson's study is intended primarily as "a guide for visitors to the scene of the two Bull Run campaigns," it is equally valuable for any one desiring a brief, accurate, and readable account of these battles. It is written for the layman, but the professional soldier and student of the American Civil War will find it profitable reading because of its careful consideration of military details.

Major Hanson remembers. He knows how worthless are most of the books of this sort in their omission of data without which military history is meaningless. He does not forget topography and weather; weapons, organization, and numbers; strategy, tactics, and logistics in the two campaigns. And his information is dependable, based on sound scholarship and years of study of the terrain.

Readers interested in ordnance material will be particularly gratified to find that Major Hanson describes the small arms and artillery on both sides with evident understanding of their rôle in battle. He tells the stories of the two campaigns in a way to emphasize the useful lessons they teach in spite of the drastic changes in the technique and tactics of the battlefield.

For the first time, visitors to Bull Run will find in this book a competent and well-illustrated guide that will unravel without excessive simplification the mysteries of the two confused battles fought there.—Donald Armstrong.

Kesselring—A Soldier's Record. By General Field Marshal Albert Kesselring. New York: William Morrow & Company. 381 pp. $5.

MARSHAL Kesselring was one of the leaders of the German defense forces who was tried, convicted, and sentenced to death. His sentence was remitted after five years in prison as an act of clemency. Originally an artillery officer who served with the German General Staff in World

ONE OF THE

World's Tallest Television Towers

RESTS ON 50 TONS OF SHELBY TUBING

● Rising high in the air, atop eastern Pennsylvania's Blue Mountain, is one of the tallest television towers in the world—the 1,036-foot transmission tower of Station WHUM-TV, Channel 61, Reading.

From its tapered base to approximately half way up—about 500 feet—the tower is constructed of 25-foot sections of 4-inch O.D. Shelby Seamless Mechanical Tubing —50 tons of it—fabricated by Stainless, Inc., North Wales, Pa.

Higher than the famous Eiffel Tower in Paris, the gigantic structure tapers down to a remarkably small triangular steel and concrete base, the three supporting sections of Shelby Tubing sloping into their concrete anchor, which is sunk 25 feet in the ground. The tremendous tower coupled with up-to-date television procedures makes Station WHUM-TV one of the most powerful stations in the world.

◀ THE TOWER WAS ERECTED in 25-foot sections—each section alternately painted red and white. In an 8-hour work day, the crew completed ten sections.

This is the type of application in which Shelby Seamless Tubing excels. Produced to exacting standards, it provides the very high uniformity of strength and dependability that only *seamless* tubing can give.

Shelby Seamless is available in a complete range of diameters, wall thicknesses, and analyses to meet the most exacting requirements. Call on our engineers. They are here to help you apply USS Shelby to your specifications.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
(Tubing Specialties)
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

SHELBY SEAMLESS MECHANICAL TUBING

UNITED STATES STEEL

Know your battle station!

In the Army every one—from the G.I. to the General—has a battle station. In case of attack every soldier knows where to report and what to do. Each is trained for his part in fighting the enemy.

So it is with the Nation. Every citizen should know his specific job for the national defense *before* an emergency arises.

Your battle station need not be a gun mount. It can be a drafting board, lathe, or desk. It can be any job related to the design, production, or maintenance of ordnance — any support extended to the Science-Industry-Ordnance Team.

In addition to regular membership services, the American Ordnance Association helps show how you may best fit into the national-defense picture.

Members are proud to belong to an Association with this active mission — *Peace through Preparedness.*

AMERICAN ORDNANCE ASSOCIATION

708 Mills Building Washington 6, D.C.

War I, he was Chief of Staff of Goering's Luftwaffe in 1936 and later one of the first field marshals of the German Air Force.

He worked with the SHAEF section of the Army Historical Division in reconstructing the German part of the World War II history. After his release from prison a few years ago he started his biography covering his military career and the lessons and observations that came out of it. This book is an honest and impartial description of the war from the air marshal's observatory written by one who enjoyed the confidence of the Führer and his other superiors until the end.

His tactical descriptions are meager, but the frank criticisms of those in staff positions and the results of their strategy decisions are pointed out objectively and without rancor. He believed in the attack on England in 1940 when Hitler hesitated. He concludes that Hitler did not want to make war on England regardless of the chance of success.

He also feels that Moscow could have been taken in the Russian campaign if Hitler had not wasted his armor on the battle of Kiev and then had winter and bad roads to face. He covers all theaters of war in like manner telling the story and his conclusions. His general philosophy is most interesting and the lessons he learned are most instructive to any military man.—T. K. VINCENT.

Commodore John Paul Jones, U. S. Navy. By Capt. Donald John Munro, R.N. New York: The William Frederick Press. 109 pp. $3.

THIS gem of biography has been published at a most appropriate time. In the sailorlike, neatly expressed prose of the well-known British naval officer author we are reminded clearly that military affairs were as deeply involved with politics and personal ambitions in American Revolutionary days as they are now when this country is a world power.

Captain Munro has succeeded in scraping away much of the folklore that has grown up around the fabulous character of John Paul Jones. He has portrayed Commodore Jones in an understanding manner and with a keen insight of a brother seaman, making wise use of many famous quotations from the American naval hero.

The numerous excerpts from letters and reports are fitted smoothly into the writing to make it clear that Jones was definitely a highly literate and educated man, courageous and independent in thought and action.

The author has not unearthed any unknown events or facets in Jones' life but brings the character of the naval hero into better focus. Any student of naval history or lover of biography who thinks this is just another story about John Paul Jones will be happily surprised when he reads Captain Munro's excellent portrayal of the first outstanding American naval leader.—J. M. P. WRIGHT.

Principles and Practice of Handloading Ammunition. By Earl Naramore. Georgetown, S. C.: Small Arms Technical Publishing Company. 914 pp. $10.

NARAMORE is no new contributor to this branch of gun lore, his "Handloader's Manual" (1937) constituting a material addition to the then-existing knowledge upon the subject. However, the 369 pages of that little work embody but a small fraction of the wordage or information offered in the present publication.

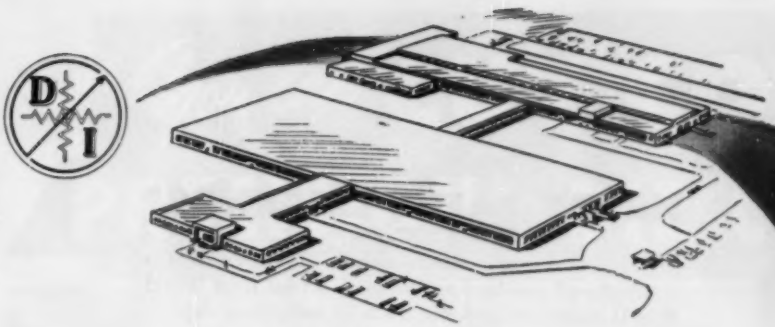
Frankly, it is difficult to conceive how any one could find the "makings" with which to fill over 900 large pages on the subject of handloading. But Naramore has done just that, and apparently without effort.

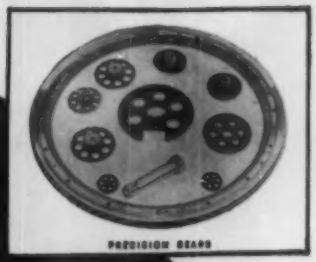
Handloading is an activity meaningful and appealing to a select few, but to the majority an uncharted wilderness. To those to whom it does appeal, let me say that they will glean from this new volume more information on the subject of which it treats than they can ever hope to use to advantage.

This book, interesting and informative as it is, suffers from many imperfections. Technically sound from the standpoint of its exposition of the engineering of small arms and small-arms ammunition, it is definitely on the juvenile level with respect to spelling, punctuation, style, etc.

However, I especially decry certain other sins of omission and commission which a little care could have prevented. Thus when we sum the instances in which the wrong word is used (*e.g.*, "power" for "powder," "thousands" for "thousandths"), conflicting statements made, description of a step in a manufacturing process omitted, incorrect inferences drawn, meanings distorted by word omissions or misspellings (*e.g.*, "Nieder" for "Niedner"), historical facts misstated, etc., we become quite unhappy.

In line with his ultra conservatism, Naramore lists no "standard" or "maximum" powder charges for any particular load. Instead he supplies "reference numbers" which appear to indicate charge weights in grains. But we are informed (p. 868) that "they are not and should not be so regarded." To learn what they *are*, you will have to buy the book and apply yourself assiduously to digesting its contents. It will be a sawbuck well spent. —CALVIN GODDARD.





PRECISION GEARS

WHAT DAYSTROM HAS TO OFFER YOU...

UNDER ONE ROOF Daystrom Instrument can meet every one of your engineering and manufacturing needs—in their modern 350,000 sq. ft. plant, where a full range of up-to-date equipment is available for manufacturing from raw materials to finished assemblies and systems . . . for complete electro-mechanical and electronic parts and assembly in any quantity . . . for internal, external, surface and centerless grinding; low to high precision turning; jig boring and milling; welding, heat treatment and finishing; precision spur and helical gear shaping, hobbing and shaving; straight and spiral beveled gearing; test and inspection for entire range of gear production.

Daystrom's Research and Development Engineers have special skills in mathematics, radar circuitry, electronic computor design and instrumentations of a similar nature . . . Daystrom's Production Engineers are specialists in the mechanical, electronic and electromechanical fields . . . Daystrom's Manufacturing Engineers are experts in tool design, processing and tooling—with a new, complete toolroom for producing jigs, dies and fixtures.

Write today for our facilities report.

ANGULAR POSITION TRANSMITTER

DIVISION OF DAYSTROM INCORPORATED

PRECISION VOLTAGE SUPPLY

DAYSTROM INSTRUMENT

ARCHBALD, PENNA.

Affiliates:
American Type Founders, Inc., Elizabeth, N.J.; Daystrom Furniture Div., Olean, N.Y.; Daystrom Electric Corp., Poughkeepsie, N.Y.

HAPPY SAFER LANDINGS!

Bigger, heavier and faster—today's carrier-based aircraft take off and land on the same carrier their World War II ancestors used, but it's a lot safer these days.

Thanks to your Navy's canted deck principle . . . to the modern catapults and arresting gear . . . the accident rate has been dramatically lessened.

E. W. Bliss Company is proud to be a member of the research and development team that makes these life-saving advances possible, proud to manufacture catapulting and arresting gear for the Navy's finest ships, proud to have its maintenance specialists chosen to service this equipment on aircraft carriers.

Easier getaways, too. Steam catapults, built by Bliss in cooperation with the U. S. Navy, launch jets in any direction relative to the wind.

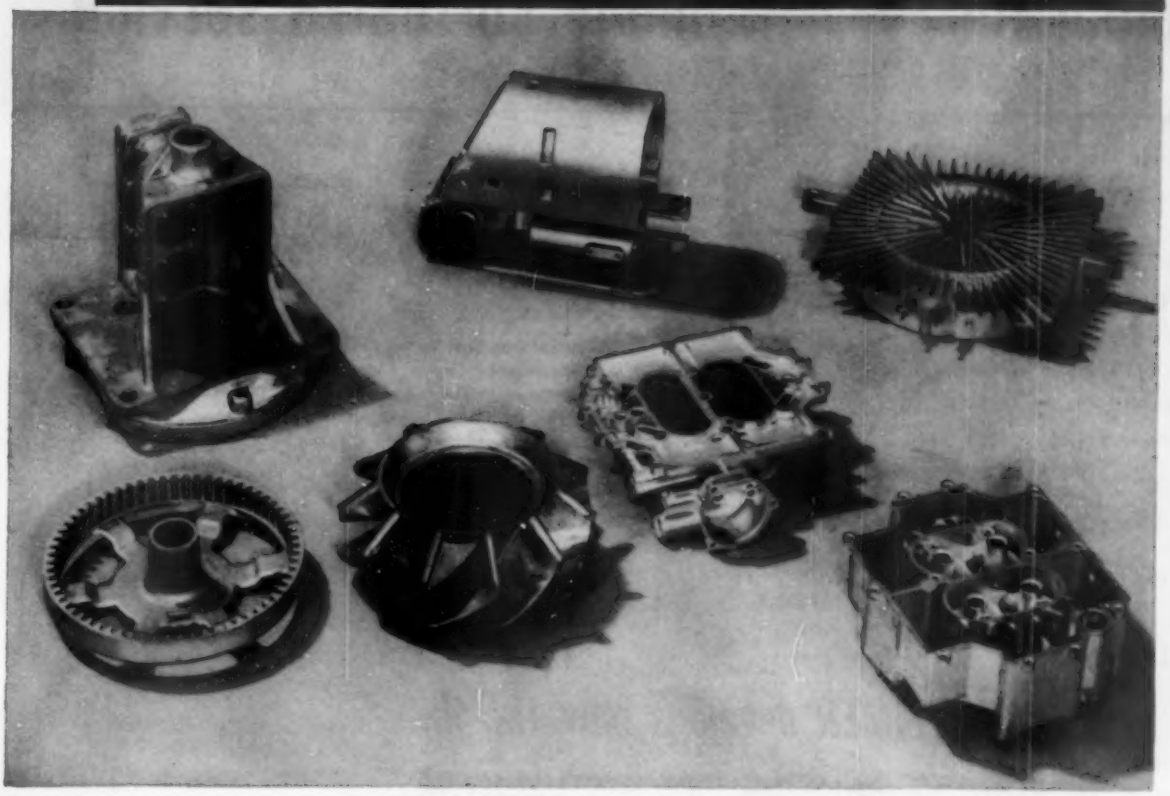
BLISS ... *for contract ordnance projects*

E. W. BLISS COMPANY

General offices: Canton, Ohio

• CATAPULTS • ARRESTING GEAR
• MACHINE GUNS • NAVAL GUN MOUNTS • SPECIAL MACHINERY

You can CUT COSTS *with* PRECISION DIE CASTINGS



FUNCTIONAL PARTS

More and more, industry is turning to die cast functional parts. In practically every case, Precision die castings offer substantial savings in producing such parts. Manufacturers in the automotive, appliance, tool and machinery industries have realized substantial savings by turning to die cast functional components.

Today's modern alloys plus Precision superior engineering ability can offer YOU substantial savings in the cost of your component parts.

Write for complete information TODAY!

PRECISION CASTINGS CO., Inc.
212 Walnut St., Fayetteville, N. Y.
Syracuse, N. Y. · Cleveland, O. · Chicago, Ill.
Kalamazoo, Mich. · Cortland, N. Y.
British Affiliation — Wolverhampton Die Casting Co., Wolverhampton, England

Ideal for mildly corrosive service

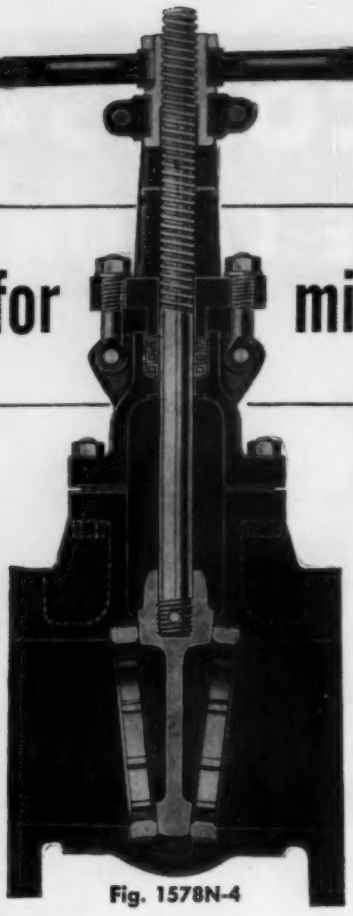


Fig. 1578N-4

3% Nickel Iron Gate Valve, Class 125 lb. . . . for process industries . . . developed and produced by The Lunkenheimer Co., Cincinnati 14, Ohio. Outside screw and yoke, bolted bonnet, flanged . . . face to face dimensions are American Standard for 125 lb. Cast Iron Wedge Gate Valves (ASA B16.10-1939).

LUNKENHEIMER develops new 125 lb. nickel-iron valve for process industries...

Mildly corrosive valve service poses a particularly tough problem in the process industries. To get *maximum* corrosion resistance, you have to pay for more than you need—high-alloy valves are expensive. And yet, ordinary cast iron often won't do the job.

An economical answer to many of these problems has been developed by Lunkenheimer with this new line of Nickel-Iron Gate Valves. Bodies and bonnets are 3% Nickel-Iron, for better corrosion resistance than ordinary cast iron, and trim is offered in choice of 18-8 (Type 316) Stainless Steel or Monel®, for maximum resistance at the point of most severe service. This combination is cutting valve costs in the petroleum field, pulp and paper, wood treating, and scores of other process industries.

This development is but one more instance that shows how nickel alloys can be used to provide significant advantages, whatever the equipment.

Many standard nickel alloyed compositions are available, making it easy to select one with extra qualities for almost any specific use. Whatever your industry, if you have a metal problem, send us details for our suggestions. Write today.

EMBLEM OF INCO SERVICE

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N.Y.

RESILIENT...COMFORTABLE TO WORK OVER

We'll admit it's pretty far fetched . . . in the Circus business there's really no substitute for a safety net. In yours, if you operate a factory, you can't beat a "Kreolite" Wood Block Floor.

Coated with "Kreolite Jennite," it is a comfortable floor to work and walk on because it absorbs noise and vibration . . . is dust-skid-and-spark-proof . . . is cooler in summer, warmer in winter. And yet it will take the punishment of massive weights, savage blows, grinding wheels as long as the factory stands. A Jennison-Wright flooring expert will call at your request.

THE JENNISON-WRIGHT CORPORATION
TOLEDO 1, OHIO • *30 Nation-Wide Offices*

SPECIFY "KREOLITE"...

Over 250 million square feet used by leading industries since 1911

1 Comfortable to Work Over
2 Durable-Stand Up Under Abuse
3 Protect Dropped Tools and Parts
4 Quick to Install—Easy to Replace
5 A Firm Foundation for Machines
6 Absorb Noise-Cut Down Vibration
7 Insulate Against Heat and Cold
8 Spark-Proof, Skid-Proof, Safe*
9 Provide for Conduits and Cables
10 Dustless-Easy to Clean
11 Good for Trucking Aisles
12 Lowest Maintenance Cost

**A "Kreolite" Wood Block Floor is cleaner and safer (because skidproof) when given a final coating of "Kreolite Jennite," our new exclusive final filler and finish that does not become tacky.*

KREOLITE WOOD BLOCK FLOORS

ALSO KREOLITE RAILROAD SWITCH & INDUSTRIAL TRACK TIES · PILING · BRIDGE & DOCK LUMBER

NOMINATION for MEMBERSHIP

in

The American Ordnance Association

A national society of American citizens dedicated to the advancement of industrial preparedness through the diffusion of Armament knowledge

To: The Secretary
American Ordnance Association
Mills Building, Washington 6, D.C.

I nominate _____
(Please print name of nominee)

_____ *for membership in the Association,*
(Street address) (City, Zone, State)

and enclose annual dues: ☐ *$4.00 for one year, or* ☐ *$10.00 for three years.*
(Please check one)

Name of Nominating Member _____

I-190

Toughest jobs on wheels . . . are jobs for Kelsey-Hayes

Keeping heavy loads on the move where the going gets tough is routine rolling for Kelsey-Hayes Wheels. They're built to take it. They're engineered for brutal punishment with an extra measure of strength and stamina for steady, trouble-free rolling on the job, any job, anywhere. And the makers of motor vehicles know this. For today, as in the past 45 years, they rely on Kelsey-Hayes for wheels of rugged dependability—wheels for trucks, trailers, tractors, buses and passenger cars.
Kelsey-Hayes Wheel Co., Detroit 32, Mich.

KELSEY HAYES

World's Largest Producer of Automotive Wheels

Wheels, Brakes, Hubs, Brake Drums, Special Parts for all Industry • 9 Plants—Detroit and Jackson, Mich. . . . McKeesport, Pa. . . . Los Angeles . . . Windsor, Ont., Canada . . . Davenport, Ia. (French & Hecht Farm Implement and Wheel Div).

FACTS ABOUT

ENGINE AND AIRPLANE CORPORATION
FAIRCHILD
Engine Division

CURRENT PROGRESS

Manufacturing skills support producability of Fairchild J44 turbojet engines for pilotless aircraft.

Ultra-sensitive equipment in modern laboratories aids in the search for new and better materials.

Plant 3, Mineola, N. Y.

This, the newest of three plants engaged in powerplant development and production, symbolizes the *planned* growth of the Fairchild Engine Division . . . and the progressive spirit of an organization that has pioneered in its field for over a quarter of a century.

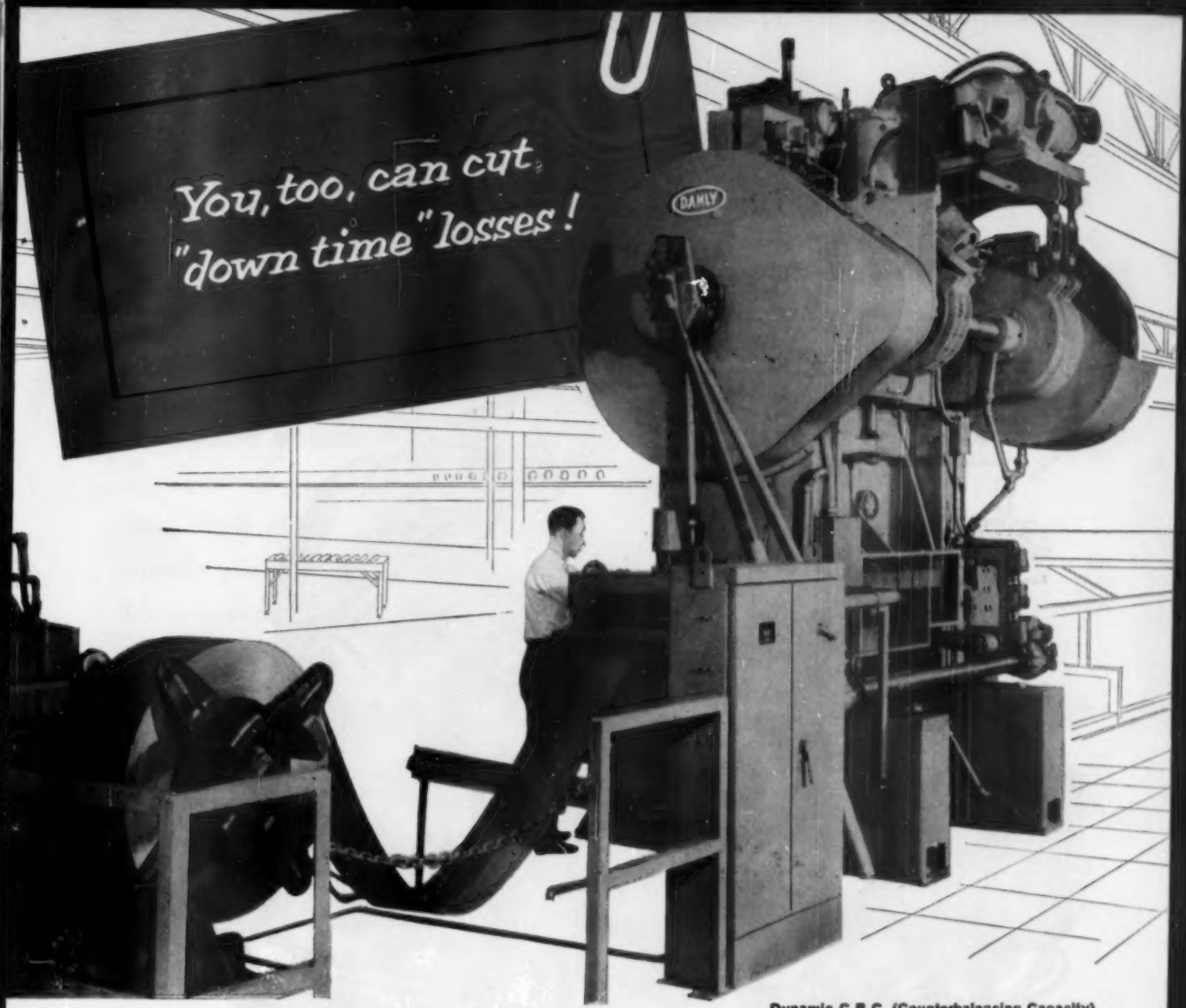
Within these modern, completely equipped plants — totaling almost one million square feet of floor space — a variety of special-purpose powerplants are being designed and produced for use on land, at sea and in the air. These include the J44 turbojet engine, developed by Fairchild for the Navy and now in volume production for each of our Armed Services, new-type propulsion systems for underwater ordnance, and auxiliary aircraft engines . . . all in addition to a greatly expanding component manufacturing program.

Today, to meet these increased responsibilities, the Fairchild Engine Division is growing bigger . . . to serve America better.

Advanced procedures maintain quality of J47 turbines, phase of large-scale component program.

ENGINE AND AIRPLANE CORPORATION
FAIRCHILD
Engine Division
FARMINGDALE VALLEY STREAM MINEOLA
Long Island, New York

AIRCRAFT DIVISION, Hagerstown, Maryland
GUIDED MISSILES DIVISION, Wyandanch, N. Y.
AMERICAN HELICOPTER DIVISION, Manhattan Beach, Calif.
SPEED CONTROL DIVISION, Wickliffe, Ohio • STRATOS DIVISION, Bay Shore, N. Y.



Dynamic C B C (Counterbalancing Capacity)... Engineered balancing of all moving parts under load plus special design of press and counterbalance capacity to meet specific job needs virtually eliminates "break-through" shock and "chucking"... makes press operation smoother, increases life of both press and dies.

Westinghouse Electric Corporation Averages 45,000 Laminations per 8-Hour Shift on a

DANLY PRESS

This is the perfect setup for steady, uninterrupted production of transformer core laminations at Westinghouse... a clear, fenced-off working area... automatic feed, slug disposal and piece part delivery equipment... and a *Danly Autofeed Press!*

Running almost continuously at a stroking rate of 120 per minute, this 150-ton Danly Press stamps out an average of *45,000 laminations during an 8-hour shift!* Since installation no maintenance has been required. Greater rigidity and precision of the Danly Press have given the expensive dies a longer lease on life, too... producing an estimated *750,000 pieces between grinds!*

New production records like this are the reasons why management men are insisting on Danly Presses in leading stamping plants throughout the country.

DANLY MACHINE SPECIALTIES, INC.

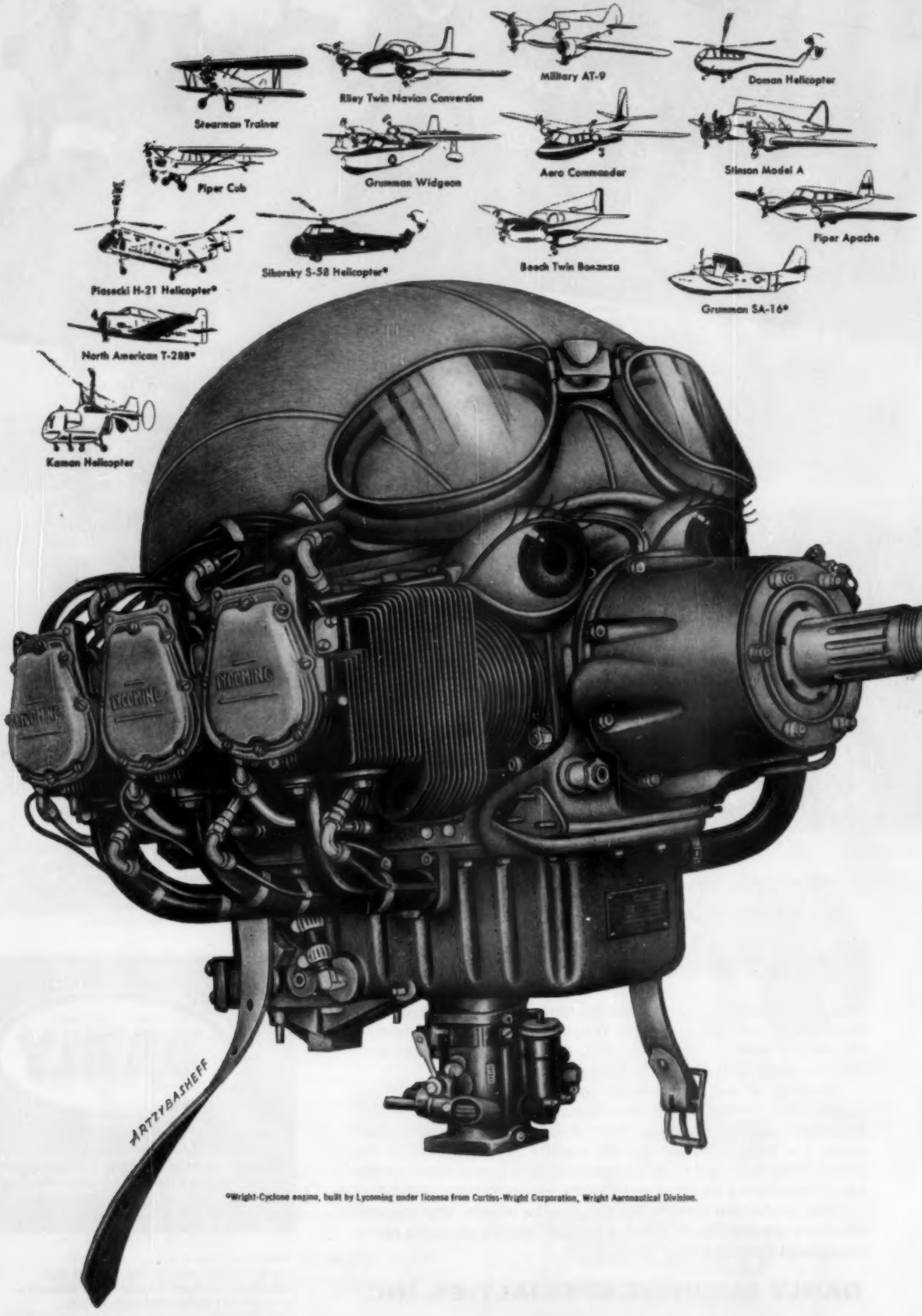
2100 South Laramie Avenue, Chicago 50, Illinois

PROVED AGAIN... It costs less to run a DANLY PRESS!

DANLY

MECHANICAL PRESSES... 50 to 3000 TONS
SINGLE, DOUBLE, TRIPLE, ACTION
AUTOFEED... UNDERDRIVE

If your manufacturing process involves high production and expensive dies, it will probably be worth your while to talk with a Danly Press Engineer. Call now—he will be glad to discuss your specific problems. There is no obligation for this service.



*Wright-Cyclone engine, built by Lycoming under license from Curtiss-Wright Corporation, Wright Aeronautical Division.

meet a "flyer" with over

250,000,000

hours behind him!

"He's" a new Lycoming air-cooled engine. He's backed by Lycoming's experience in creating and producing 50,000 aircraft power plants . . . each with a flight-proved life expectancy of at least 5,000 hours.

You learn a lot about flying in 25 years.. and 50,000 engines!

Our first Lycoming aircraft engines gained us invaluable experience flying for one of America's first scheduled air lines a quarter-century ago. Year after year, their successors have flown military missions in a variety of aircraft from liaison planes, to trainers, to helicopters. As civilians, they now fly everything from small single-engine utility planes . . . to America's leading twin-engine "flying offices" for businessmen.

Do *you* need this kind of dependable air-cooled power . . . or any of the diversified services listed above our signature? Lycoming's wealth of creative engineering ability... its 2½ million square feet of floor space... and 6,000-plus machine tools stand ready to serve you. *Whatever* your problem... *look to Lycoming!*

Just off the press! "The Lycoming Story"... 40 interesting, illustrated pages showing many ways Lycoming is ready to help you. Write for it on your letterhead.

Aircraft Engines
Industrial and Tank Engines
Engine Overhaul
Generating Units

Turbine Engineering and Research
Engineering Design and Development
Hardened and Ground Precision Parts
Gears and Machine Parts

Complete Assemblies
Heat-Treating and Plating
Steel Fabrication
Castings
Boilers

ENGINEERS WANTED:
Long-term U. S. Air Force contracts for gas-turbine power plants provide unlimited opportunities for top-flight experienced engineers. Openings, too, in radial engine development, for stress analytical and project engineers. Assistant... Vice-President, Industrial Relations, Stratford, Conn.

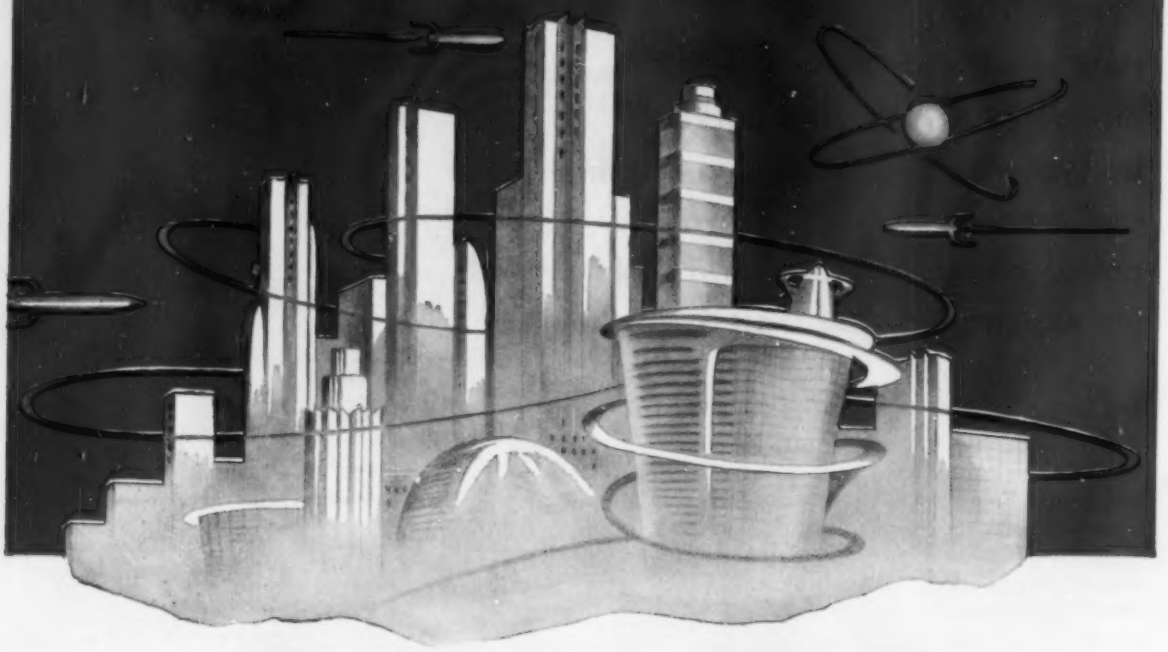
FOR RESEARCH · FOR PRECISION PRODUCTION

LOOK TO **Lycoming**

DIVISION OF AVCO STRATFORD, CONN.
Manufacturing plants in Stratford, Conn., and Williamsport, Pa.

BORG *An Important Name*

...IN TECHNICAL RESEARCH • IN PRODUCTION PERFORMANCE



THIS RESPECTED FACILITY
Has Consistently Served the
ARMY • AIR FORCE • NAVY

Borg Production Facilities

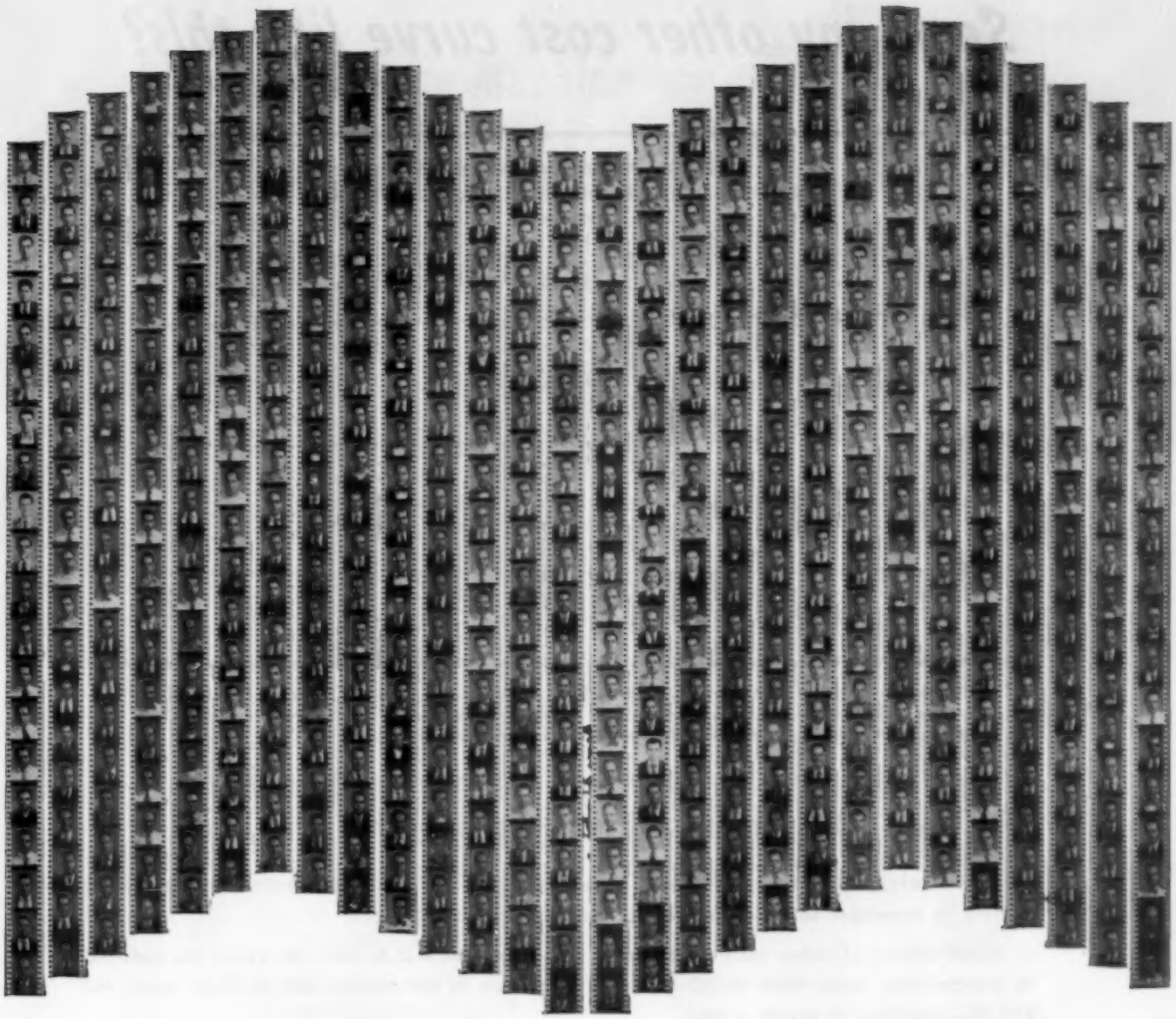
Highly skilled technicians, extensive engineering and chemical laboratories and over 350,000 square feet of plant capacity combine to make Borg a dependable supplier wherever precision and production are required.

Typical Borg Products

- Electrically Wound Automotive Clocks and Time Instruments
- Mechanical Time Fuzes
- Fuze Timing and Regulating Equipment
- Aircraft Instruments
- Precision Multi-Turn Potentiometers
- Custom-Built Electronic Equipment
- Frequency Standards
- Deep Pile Fabrics

THE GEORGE W. BORG CORPORATION • DELAVAN, WISCONSIN

PLANTS: Delavan, Wisconsin; Chicago, Illinois; Janesville, Wisconsin; Jefferson, Wisconsin



you are looking at 560 electronics engineers

This concentration of mindpower—the equivalent of nearly 4,000 years of experience in the new science of electronics—is part of a team of 2200 specialists in the Engineering Division of Martin. It is also part of a major development in the aircraft industry.

For the electronics requirements of today's weapons systems are an increasingly critical factor in the cost of airpower, involving navigation, guidance, search, fire control, communications and a rapidly growing number of operational functions.

Martin's top-rated electronics resources are a vital part of the balanced and integrated system of engineering skills essential today to the production of optimum weapons systems at maximum efficiency and economy.

Take the case of the U.S.A.F. B-61 Matador, America's first successful pilotless bomber:

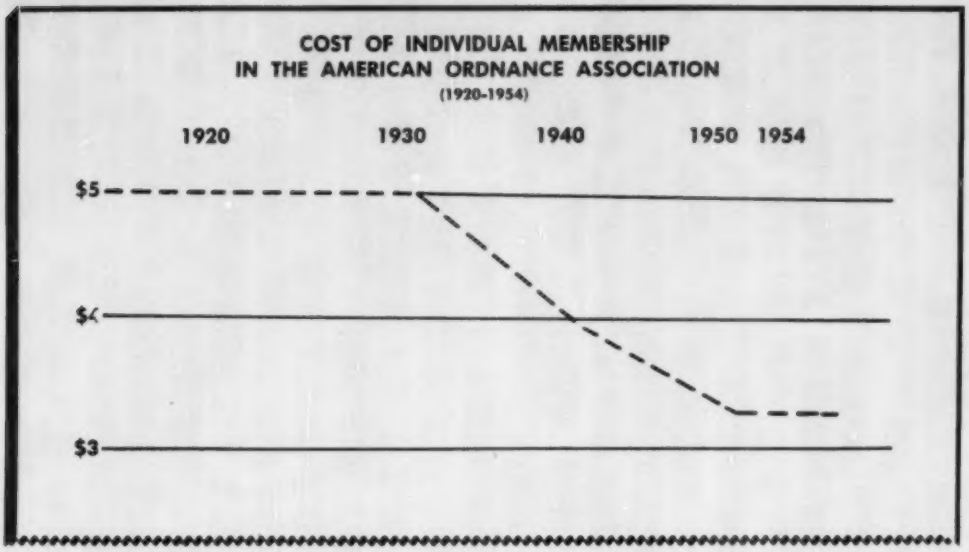
This major weapon is being produced for a fraction of the cost-per-pound of equivalent piloted aircraft... another long-range payoff on Martin Systems Engineering, which is delivering more airpower at less cost to our Government and the American taxpayer.

You will hear more about Martin!

Martin AIRCRAFT

THE GLENN L. MARTIN COMPANY
BALTIMORE • MARYLAND

Seen any other cost curve like this?



Annual membership dues were $5.00 when the Association was founded. Later, to broaden the scope of the Association, dues were reduced to $4.00 a year. Then a further reduction (to $3.33 per year) was made possible with the special rate of three years for $10.00.

Your A.O.A. membership costs less today than ever before

☆ **Never before in its thirty-five years of existence has the American Ordnance Association offered its members so much service for such little cost.**

☆ **While almost all other costs have continued to rise, the A.O.A. over the years has reduced its membership dues from $5.00 to $4.00 and then to the present rate of three years for $10.00—less than a penny a day!**

☆ **Yet over the years membership privileges have been continually increased so that today members receive greater value than ever before.**

For less than a penny a day A.O.A. members now receive:

1. **Ordnance, the bimonthly journal of scientific and industrial preparedness.**
2. **The Common Defense, the Association's monthly Washington newsletter.**
3. **An embossed membership card.**
4. **The privilege of wearing the insignia of the Association—medal, ribbon, or pin.**
5. **Membership in a local A.O.A. Post with its attendant activities.**
6. **Participation in the Ordnance Book Service, with substantial savings on the latest books.**
7. **Many other privileges and services including special reports, plant visits, seminars, national meetings, dinners, and conventions.**

AMERICAN ORDNANCE ASSOCIATION
Mills Building, Washington 6, D.C.

Why not tell a friend about the A.O.A. today?

Stokes Ordnance Machine

Performs 18 separate operations

automatically and continuously

on this complete Fuse assembly

Hopper-selected parts are formed into complete assemblies at a rate of thousands per hour. Operations include not only the simple put-together, screw-in, staking, crimping and sealing operations but such delicate steps as checking for height, depth and angle.

Automatic Stokes machines of this type — specially designed by our Ordnance Division for ordnance manufacturers — are the result of 60 years of concentration on the manufacture of automatic machinery.

Our engineering comprehends...

(a) Reduction of unit cost by fully automatic operation, minimum supervision requirements, and minimum rejects.

(b) Adaptability of special-purpose machines for changeover to production of different components.

(c) Protection of personnel and property by elaborate mechanical and electrical controls.

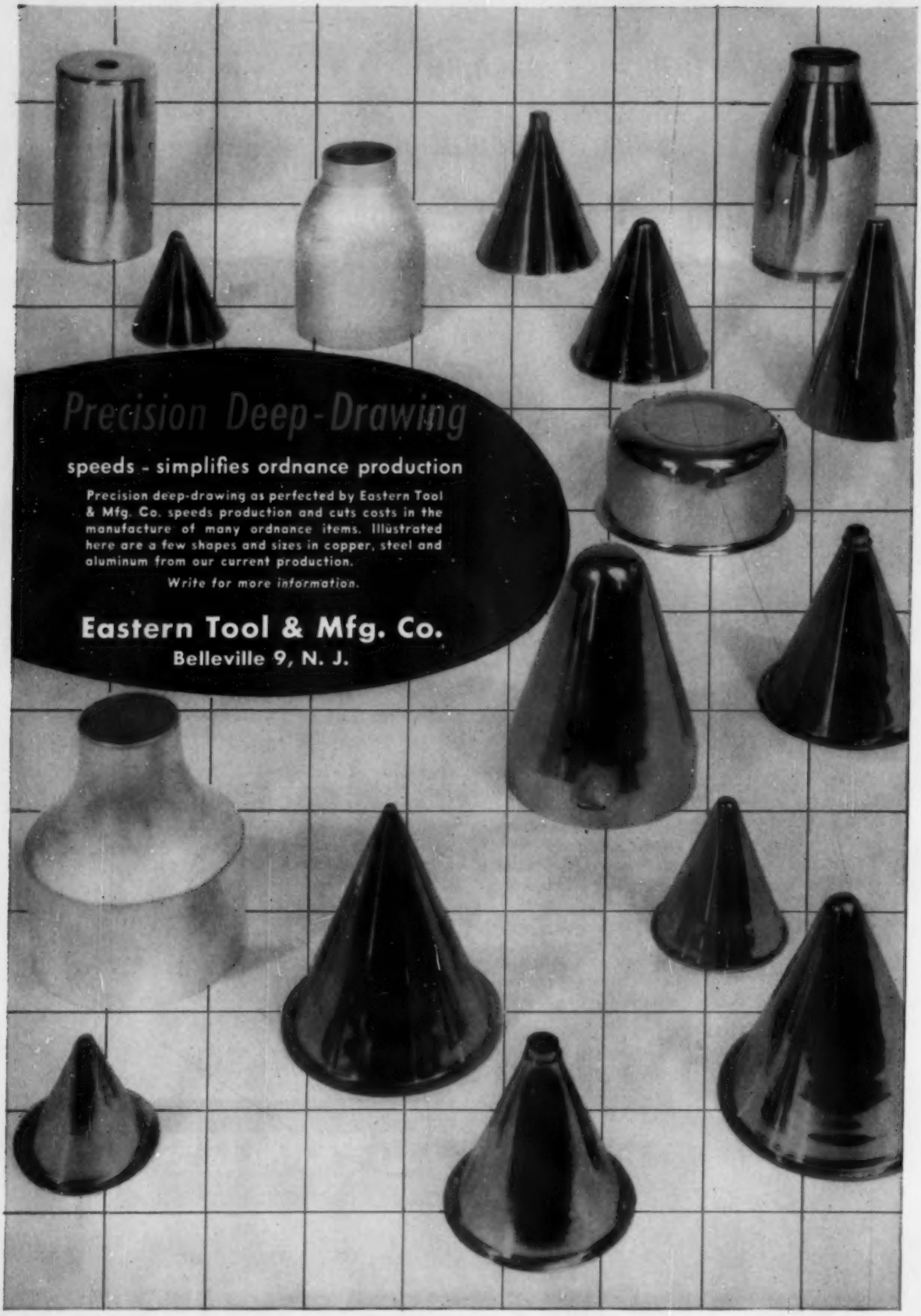
Similarly, automatic Stokes machines are available for the continuous consolidation of many explosive charges. The Model 192 Loading Press makes and inserts tetryl booster pellets and TNT pellets. Model 193 consolidates tetryl lead charges . . . all at high speeds and under remarkable safeguards.

The experienced counsel of Stokes experts on Automatic Ordnance Loading equipment is available to you on request.

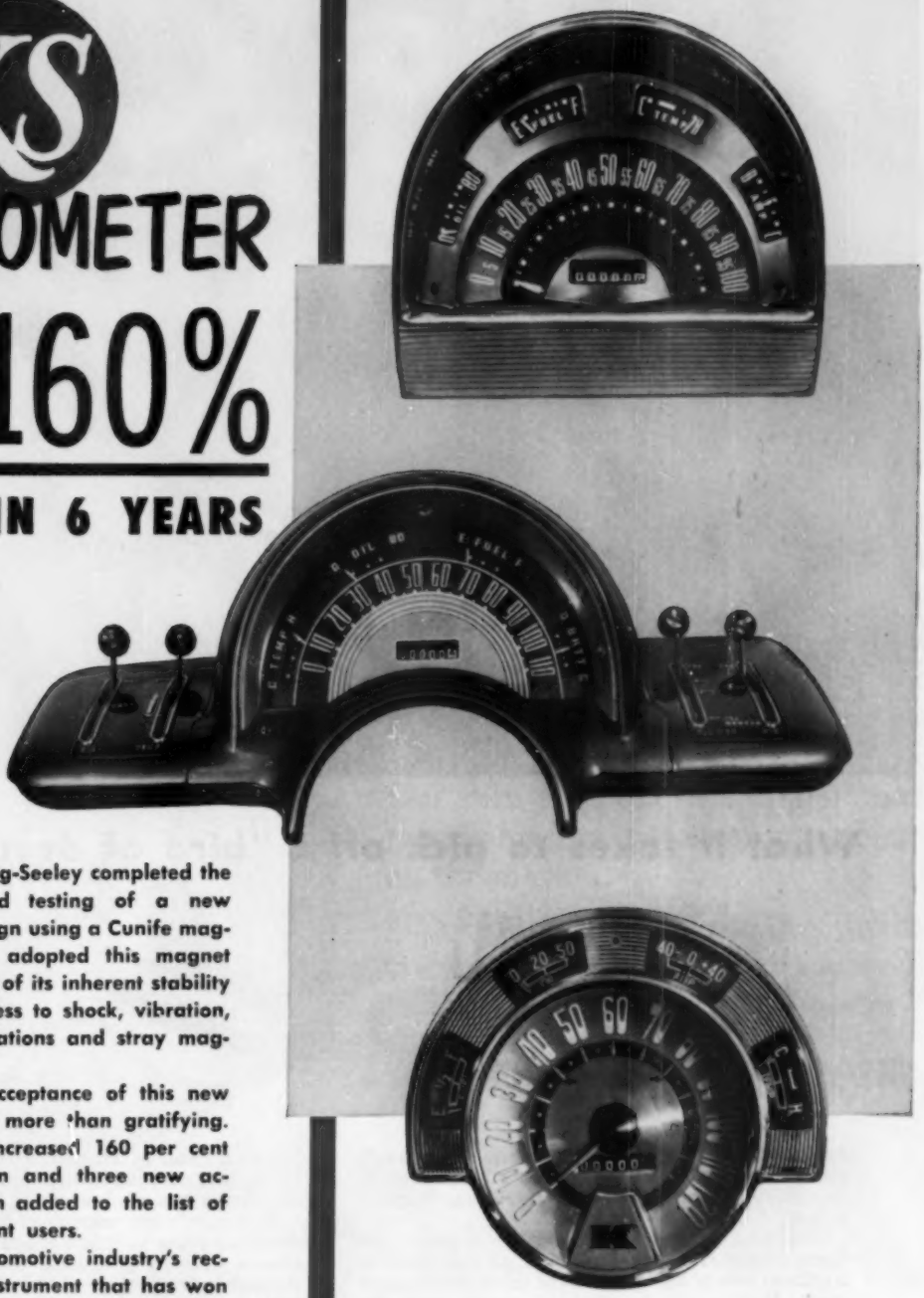
F. J. Stokes Machine Company
Ordnance Division
Philadelphia 20, Pa.

STOKES

STOKES MAKES: High Vacuum Equipment, Vacuum Pumps and Gages / Industrial Tabletting, Powder Metal and Plastics Molding Presses / Pharmaceutical Equipment


Precision Deep-Drawing
speeds - simplifies ordnance production
Precision deep-drawing as perfected by Eastern Tool & Mfg. Co. speeds production and cuts costs in the manufacture of many ordnance items. Illustrated here are a few shapes and sizes in copper, steel and aluminum from our current production.
Write for more information.
Eastern Tool & Mfg. Co.
Belleville 9, N. J.

DEMAND FOR KS SPEEDOMETER UP 160% IN 6 YEARS



Early in 1948 King-Seeley completed the development and testing of a new speedometer design using a Cunife magnet. King-Seeley adopted this magnet material because of its inherent stability and imperviousness to shock, vibration, temperature variations and stray magnetic fields.

The general acceptance of this new design has been more than gratifying. Production has increased 160 per cent since its adoption and three new accounts have been added to the list of original equipment users.

This is the automotive industry's recognition of an instrument that has won the car owner's complete approval.

KING-SEELEY CORPORATION
ANN ARBOR, MICHIGAN
Plants at ANN ARBOR, SCIO and YPSILANTI

6611

What it takes to pick off a "bird of destruction"!

Carbon Steel
44,469 lbs.

+

Copper and Brass
3,956 lbs.

+

Nickel
140 lbs.

+

Machine Operation
30,000 hours

All these elements add up to just one anti-aircraft unit! An aircraft carrier requires a battery of 20 to provide the principal protective cover from air attack.

American Machine & Foundry Company produces certain component mechanisms that perform a critical role in the operation of these anti-aircraft units. Here again, by working closely with the Naval Bureau of Ordnance, AMF's engineering ability and manufacturing facilities help to supply the answer to a vital need.

This is only one example of the job American industry is doing to insure effective military preparedness. Only by producing better products faster through individual *speed* and *skill* can we keep our nation militarily alert.

Above figures given with due regard for security.

AMERICAN MACHINE & FOUNDRY COMPANY

Executive Offices, 261 Madison, New York 16, N.Y.

AMF does it better—automatically!

CREATORS AND PRODUCERS OF ELECTRONIC AND MECHANICAL EQUIPMENT FOR THE ARMED SERVICES: Radar antennae and drive units • automatic loaders for Army and Navy weapons • elevating and azimuth mechanisms • cooling fans for Army tanks • airplane parts • mobile ovens • electronic training devices • naval ordnance • rolled and welded steel products • shell components • silver-zinc batteries • special military projects

SHELLS to keep the peace

MATTRESSES for peaceful sleep

Both from

Englander

Like making both swords and plowshares, The Englander Company makes both shells for the Army and mattresses for everyone.

We're as proud of one as of the other. Naturally we're gratified to be chosen to supply arms to men who guard their country. And we feel sure that our Englander mattresses are the best sleep equipment on the market.

They're the mattresses that justify our saying, *"No matter how you sleep, you'll sleep better on an Englander!"*

THE ENGLANDER COMPANY, INC.

Englander Airfoam Ensemble features the Sleep that's Three Layers Deep. First the Englander mattress of Goodyear Airfoam* . . . the only genuine Airfoam mattress made. Besides giving unmatched comfort, it never sags—never lumps—never needs to be turned (And how your wife will appreciate that!) Then the famous Englander Red-Line* Foundation —the *only* foundation especially made for an Airfoam mattress. Springs in the upper layer act independently to fit the contour of your body, and the lower layer gives firm, healthful support.

Englander

THE FINEST NAME IN SLEEP

*TM The Englander Company, Inc.
*TM The Goodyear Rubber & Tire Company

24 parties on one line
but nobody ever has to wait!

Suppose *you* owned a telephone company with service between two small towns ten miles apart. Suppose further that each town had a sudden growth in population so that the low-rate toll calls between the two grew and grew.

A knotty problem, that! Your subscribers would protest loudly if they found the line constantly busy. And you could go broke, quickly, if you started installing long lines of extra poles and wire to handle 15c and 25c calls.

Many small American telephone companies solve this problem neatly with Stromberg-Carlson "Carrier" equipment. In simple language, Carrier equipment is an ingenious electronic device which—on *one* pair of wires (going and coming)—impresses electrical currents of different frequencies. Subscribers who dial or ask the operator for the nearby town automatically get a frequency that's open for use—and as many as twenty-four (or more) can all talk at once over the same wire!

Similar ingenious solutions to problems are part of our regular service to the armed forces of our country. If there is a Stromberg-Carlson label on some of *your* equipment, you can be sure you have the best!

There is nothing finer than a

Stromberg-Carlson® Rochester 3, New York

STROMBERG-CARLSON LEADS TOO IN:

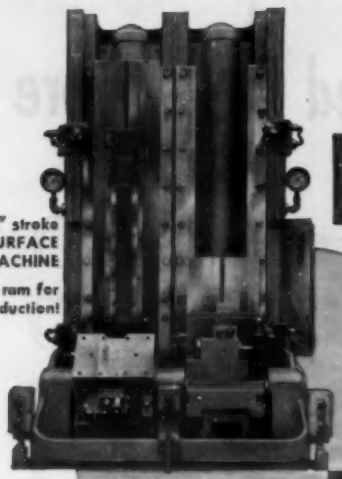
"Panoramic Vision" Television Receivers

High Fidelity Radios and Radio-Phonographs

Sound and Public Address Systems

Office Intercom Equipment

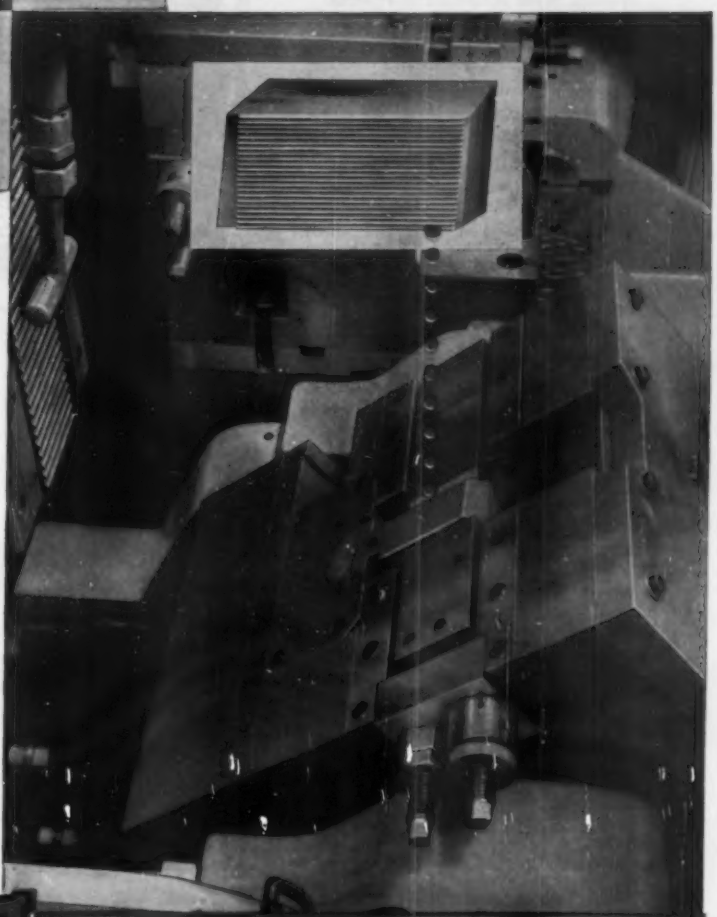
Electronic Carillons for Churches and Public Buildings



10 ton, 42" stroke
DRV SURFACE
BROACHING MACHINE
Double ram for
fast production!

with this
RUGGED
LAPOINTE
BROACHING MACHINE
and this
RIGID
TIP-DOWN* FIXTURE

Send for Bulletin DRV-14



you can
BROACH
400
high speed steel
MILLING CUTTER INSERTS
per hour!

...and here's the exciting news:
25 different sizes broached
with minimum interchange
of adapter blocks.

Exclusive LAPOINTE TIP-DOWN MASTER FIXTURE for safe and convenient handling of parts.

Parts are automatically clamped hydraulically, but manually released for reloading.

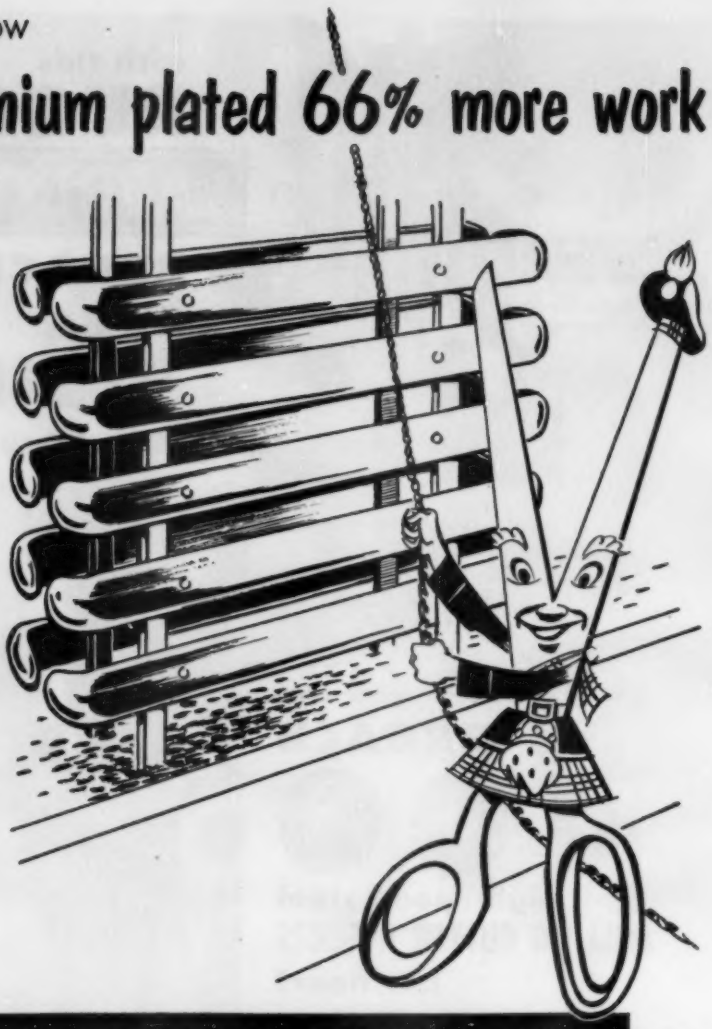
*Exclusive with LAPOINTE

THE LAPOINTE MACHINE TOOL COMPANY
HUDSON, MASSACHUSETTS • U. S. A.
In England: Watford Hertfordshire

THE WORLD'S OLDEST AND LARGEST MANUFACTURERS OF BROACHING MACHINES AND BROACHES

MR. COST CUTTER SHOWS HOW

Same power chromium plated 66% more work



Six automobile bumpers were the maximum tank load per plating cycle when the ordinary chromium plating solution was used by one supplier. Any bigger load covered poorly, with consequent rejects.

Then this supplier made a simple change-over. At the recommendation of United Chromium, the ordinary chromium bath was replaced by the Unichrome SRHS Chromium Solution.

Results were actually better—and cheaper, of course—than *physically* expanding the plant's capacity. With this up-to-date chromium bath, *ten* bumpers could be plated, and with no need for additional investment in power! The finish was also produced faster, and with fewer rejects. To top it all, bath upkeep costs dropped, too.

MORE WAYS UNITED CHROMIUM HELPS TO SAVE ON COATING OF METALS

Lower cost protection
In auto plant, Unichrome Plastisol Compound was applied to conveyor hooks much faster and cheaper than the rubber used formerly to prevent scratching of parts. It also lasted twice as long.

Saves on maintenance
One plant standardized on applying Ucilon® 1601 Aluminum Protective Coating every two years to outdoor metalwork — because it not only prevented rusting but also *stayed* bright and attractive.

Tantalum cuts expenses
Unichrome Tantalum Coils are acidproof to most common acids. Used in a chromium bath, one such installation paid for itself in a year by eliminating downtime losses formerly experienced.

TO FINISH IT BETTER AND SAVE

call in "The Unichrome Man"

UNICHROME
Trade Mark

It pays to consult United Chromium on Metal Finishing Problems

United Chromium offers you the advantages of: (1) 25 years of specialized experience in metal finishing; (2) Wide experience in both organic and plated finishes; (3) A diversified line of products for decorative and functional finishing — including plating processes, protective coatings, chemical conversion coatings for zinc, equipment; (4) Thinking geared to cost-cutting, product-improving possibilities.

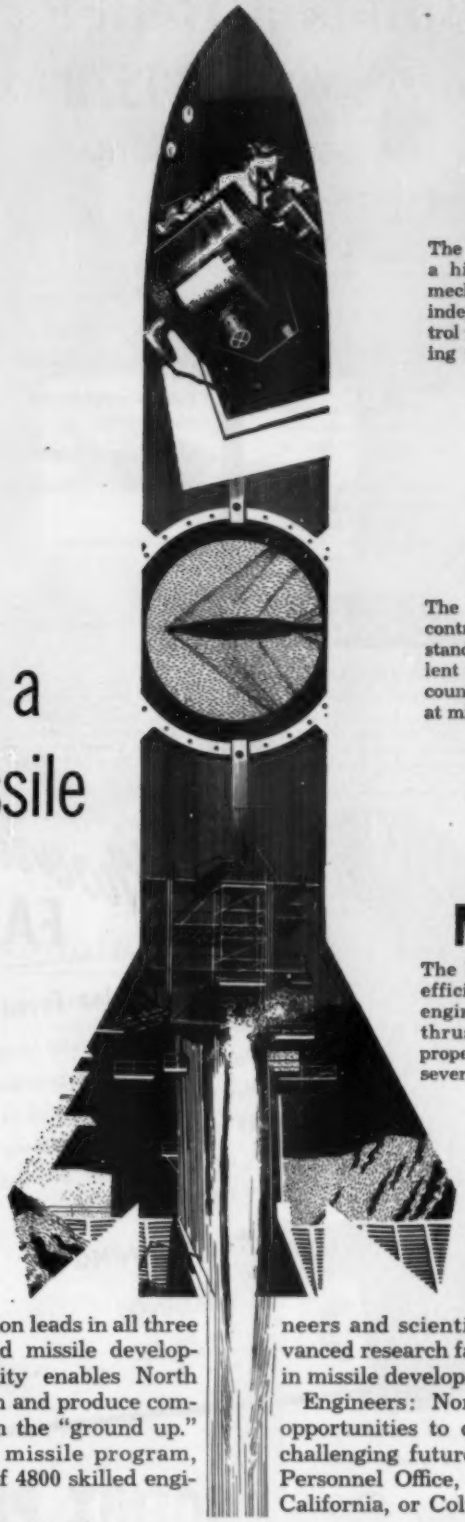
We'd welcome an opportunity to help you "Finish it better AND SAVE."

UNITED CHROMIUM, INCORPORATED 100 East 42nd St., New York 17, N. Y.

Waterbury 20, Conn. • Detroit 20, Mich. • Chicago 4, Ill. • Los Angeles 13, Calif. In Canada: United Chromium Limited, Toronto, Ont.

NORTH AMERICAN HAS BUILT MORE AIRPLANES THAN ANY OTHER COMPANY IN THE WORLD

It takes all Three to make a Guided Missile



BRAIN

The Guidance Mechanism — a highly complex electro-mechanical unit that operates independent of ground control while automatically guiding the missile to its target.

FRAME

The Airframe — the body and control surfaces must withstand great stresses and violent temperature changes encountered in supersonic flight at miles-high altitudes.

MUSCLE

The Power-Plant — a super-efficient, liquid fuel rocket engine producing immense thrust... power enough to propel the missile at speeds several times that of sound.

Only North American Aviation leads in all three phases of long-range guided missile development. This unique capability enables North American to conceive, design and produce complete guided missiles... from the "ground up." North American's guided missile program, drawing on the experience of 4800 skilled engineers and scientists... aided by the most advanced research facilities... speeds our progress in missile development for national defense.

Engineers: North American offers unusual opportunities to qualified engineers seeking a challenging future. Please write: Engineering Personnel Office, Los Angeles 45 or Downey, California, or Columbus, Ohio.

organization, facilities and experience keep

North American Aviation, Inc.

years ahead in aircraft... atomic energy... electronics... guided missiles... research and development.

Bendix Builds a Better *cable clamp* the AN3057B

Inexpensive • Efficient • Versatile

The new Bendix AN approved AN3057B cable clamp is now available. Engineered by Bendix to the highest quality standards, this cable clamp offers major design improvements. The clamping action is radial and completely eliminates wire strain and chafing by holding the wire bundle firmly in rubber. This clamp will accommodate a wide range of wire bundle sizes, but an even greater range can be handled through the use of the Bendix AN3420A accessory telescoping sleeve.

The new AN3057B cable clamp will also waterproof multi-conductor rubber covered cable on the rear of a connector, or where moisture-proof entrance through a bulkhead or into an equipment box is required.

This versatile clamp is a product of the Scintilla Division of Bendix Aviation Corporation and is a companion AN accessory to the world famous Bendix Scinflex line of electrical connectors. Write our Sales Department for details.

Outstanding Features

- Neoprene gland.
- Centered clamping action.
- Increased close down.
- Positive grounding feature.
- Cadmium plated die-cast aluminum nut.
- Shorter over-all length.
- Waterproofs multi-conductor cable.
- Immediate delivery.

Bendix

SCINTILLA DIVISION of Bendix AVIATION CORPORATION
SIDNEY, NEW YORK

FACTORY BRANCH OFFICES: 117 E. Providencia Ave., Burbank, Calif. • American Bldg., 4 S. Main St., Dayton 2, Ohio • Stephenson Bldg., 6560 Cass Ave., Detroit 2, Michigan • 512 West Ave., Jenkintown, Pa. • Brouwer Bldg., 176 W. Wisconsin Avenue, Milwaukee, Wisconsin • 8401 Cedar Springs Rd., Dallas 19, Texas • EXPORT SALES: Bendix International Division, 205 East 42nd St., New York 17, N. Y.

Phoenixspun FABRICATING...

Solves Production-Forming Problems Like This—

SPINNING "jumbo" sized forms like this inlet bell for a large ventilating blower is no problem the PHOENIXSPUN way! — A rolled and welded sheet of 14-gauge steel becomes an inlet bell 24" deep and 72" in diameter, under the skilled hands of master craftsmen. Large or small, your special forming needs can be served as readily.

METAL SPINNING

WELDING
(Inert Gas, Arc, Oxy-Acetylene)

DEEP DRAWING
(To 350 Tons)

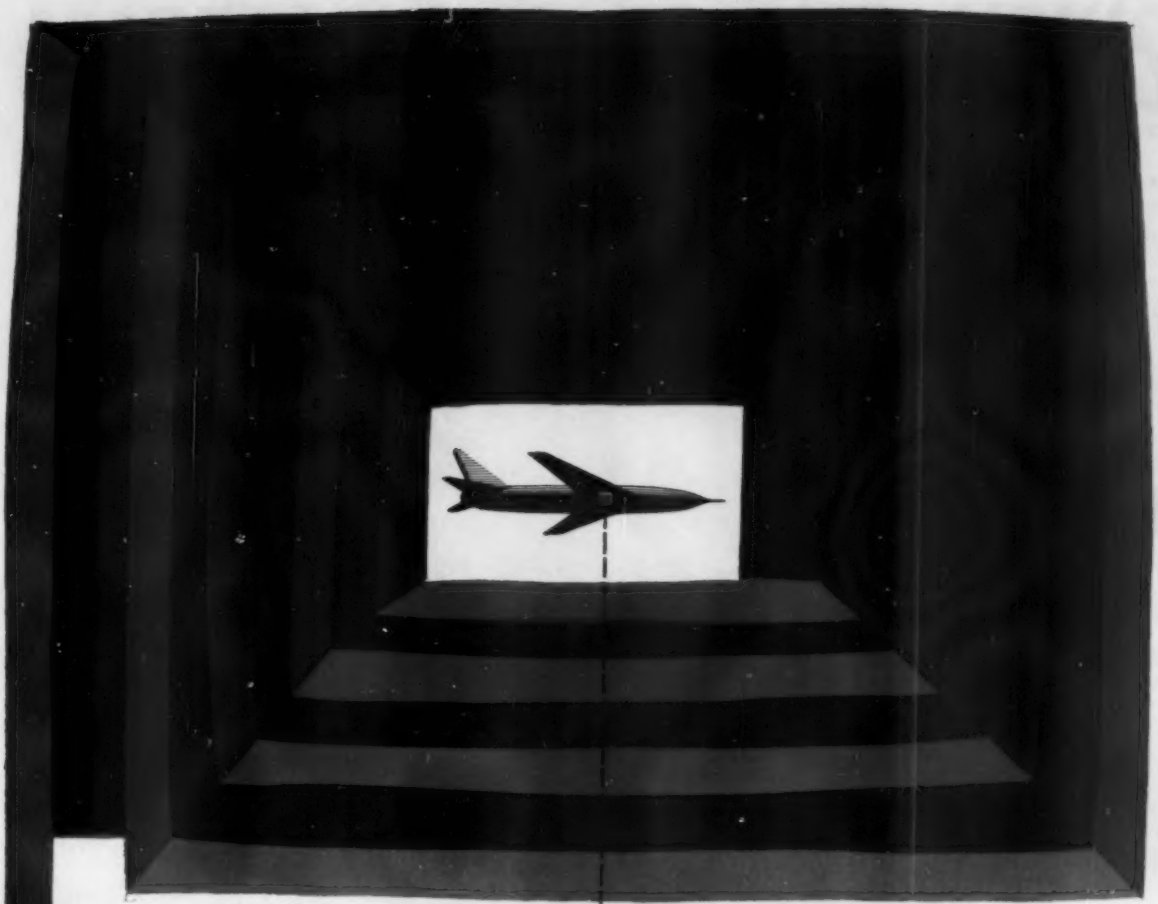
FABRICATING

ASSEMBLING

WRITE for Illustrated Bulletins, or send prints and specifications for prompt quotations.

Metal Spinning Div., **PHOENIX PRODUCTS CO.**

4735 N. 27TH STREET • MILWAUKEE 16, WISCONSIN



CROSLEY *miniatures* LIGHTEN THE LOAD!

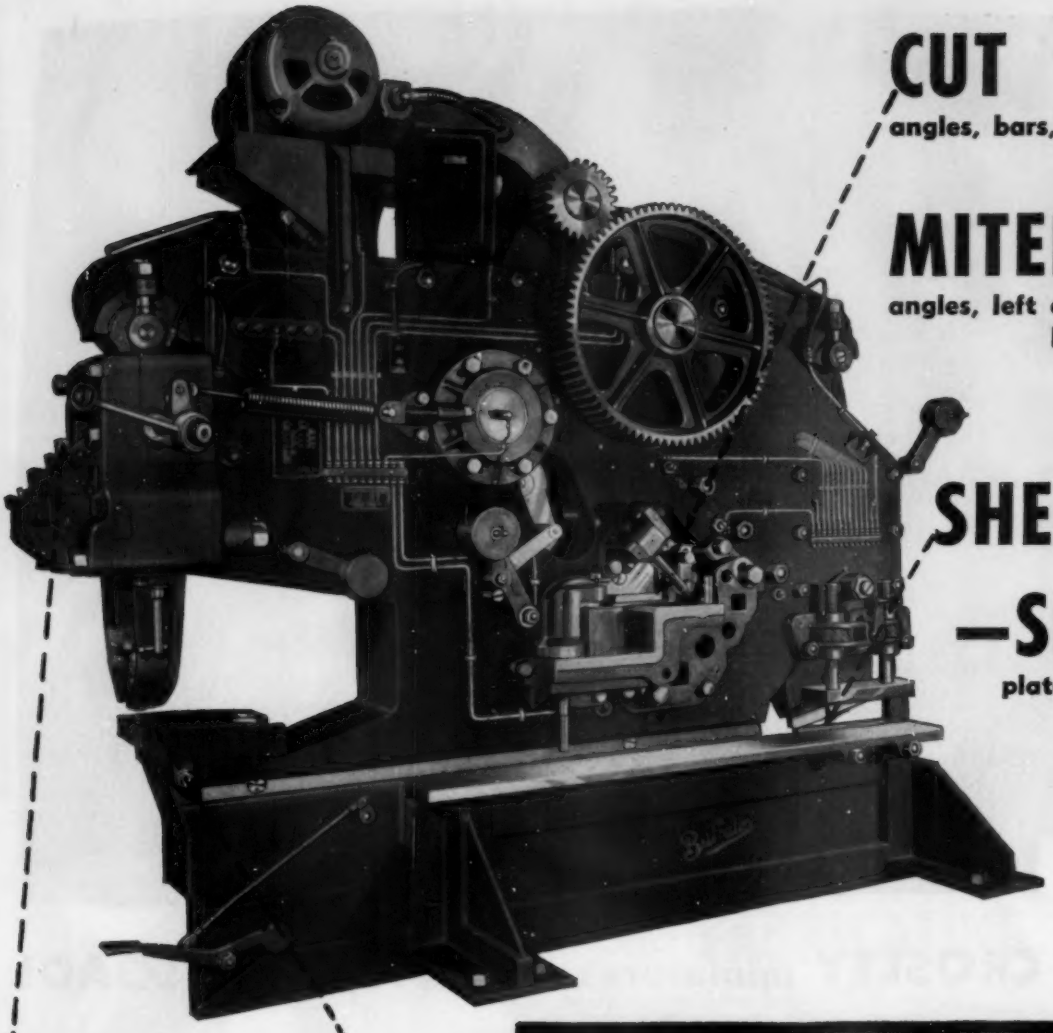
AND INCREASE EFFICIENCY! Current proof is Crosley's new, miniaturized Glide Slope-Localizer Receiver for aircraft instrument landings. It's 40% lighter, 24% smaller, requires less power, provides easier installation and maintenance, improves reliability.

In addition to the Air Force, Crosley is streamlining vital equipments for the Army, Navy and Signal Corps—minimizing weight, size and maintenance, reducing manufacturing effort and cost.

Military demands in all phases of electronic, mechanical and electro-mechanical production meet quick response in Crosley's flexible facilities and manufacturing skills. From miniaturized components to weapons systems and airframe assemblies, Crosley maintains rigid government standards—delivers promptly.

"Right and On Time," an illustrated booklet describing Crosley facilities for military production, is available to Procurement Agencies and other defense contractors. Be sure to send for your copy today!

CROSLEY
GOVERNMENT PRODUCTS
DIVISION AVCO MANUFACTURING CORPORATION
CINCINNATI 15, OHIO



CUT
angles, bars, tees

MITER
angles, left or right hand

SHEAR
—SLIT
plate, flats

NOTCH PUNCH
in webs and flanges of standard beams and channels

"BUFFALO" U. D. MACHINE DOES YOUR BIG FABRICATION JOBS!

Designed to handle even larger capacity high-speed work than the famous "Buffalo" Universal Iron Worker, the Universal Diagonal Machine is available in Nos. 3½ and 4½ sizes with 20" and 30" punch throats respectively. The No. 4½, shown, has built-in notcher in the punch head (with 5" x 1/2" capacity for angles). Interchangeable high and low die blocks on the punch end permit handling beams, channels, girders, Bethlehem beams and H-columns. Die blocks and stripper bars are arranged for quick changing to set up for different sections.

The quick-raising shear strippers are sturdily built and clamp the stock the full length of the knife. Frames are electrically welded steel, the strongest construction known. The bar cutter will shear up to 3" rounds, 6½ x 6½ x 6½ tees (90°), 6" x 5/8" angles (45°) and 6" x 7/8" angles (90°). Many special tools are available for a wide range of other fabrication jobs described in Bulletin 360-F. WRITE FOR YOUR COPY.

In addition to the above, we build larger machines having a capacity up to and including ability to shear 8 x 8 x 7/8" angles, 3-3/4" rounds, 3-1/4" squares, beams and channels up to 15", 10" H-columns, 1-1/2" plate, and a punching pressure of 250 tons.

"Buffalo"

BUFFALO FORGE COMPANY

534 Broadway Buffalo, N. Y.

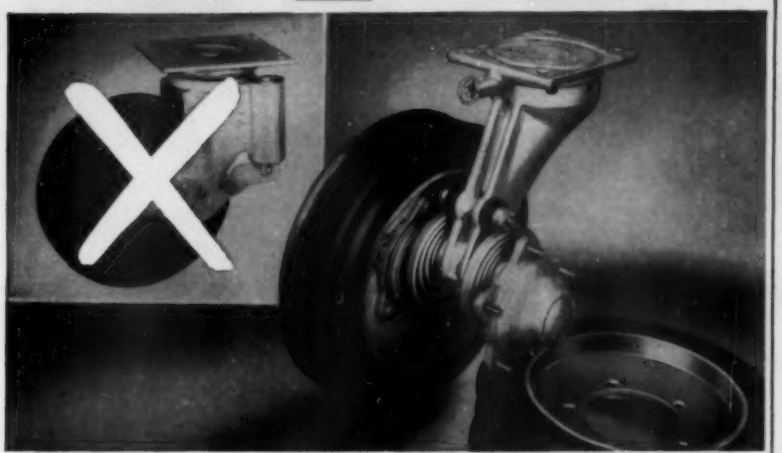
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

DRILLING PUNCHING SHEARING BENDING

MATERIALS-HANDLING NEWS

★ Panel Discussions by Bassick, World's Largest Manufacturer of Casters and Floor Protection Equipment ★

Only caster made to absorb vertical and horizontal shocks



ROCKER-TYPE spring-mounted caster originated by Bassick — discarded in 1939.

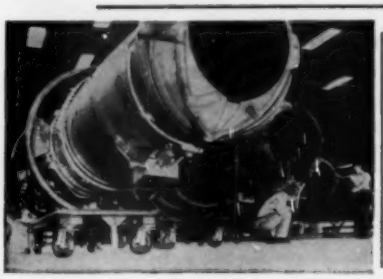
1954 "FLOATING-HUB" caster for 20-mph service, showing construction details.

15 years ago Bassick discarded "baby carriage bounce" system

You get *true* shock absorption in a Bassick "Floating-Hub" caster.

Unlike recently introduced spring-loaded, rocker-type casters, "Floating-Hub" casters absorb *both* horizontal and vertical shocks. Patented construction actually "floats" spring-controlled wheel in the frame, providing mechanical resiliency between rim and axle. Even over bumps and rough surfaces, all four wheels remain in contact with the floor — giving fragile and liquid cargoes a safe ride.

"Floating-Hub" casters have built-in snubbing action to give genuine shock absorption — an exclusive Bassick feature. They can't wobble, either, because wheel is kept rigid. Write for new Booklet FH-53, for facts on where and how to use Bassick "Floating-Hub" casters.



GE turbojet engines ride to inspection on "Floating-Hub" casters

You're looking at the business end of a big General Electric Company J-47-17 turbojet engine. It powers the U.S. Air Force's crack F-86D jet fighter plane to near-sonic speeds with help of afterburner. GE entrusts these jewel-like engines to Bassick "Floating-Hub" casters for safe handling.

Three new medium-duty "Floating-Hub" casters for 100- to 1000-lb. loads

Series "FG" Airliner caster for high-speed service. "Floating-Hub" plus rubber "Floatread" wheels absorb shocks. 10" and 12" sizes.

Series "09" caster with "Floating-Hub" shock-absorbing action comes in 5½" and 7" dia. wheels. Rubber or semi-steel treads.

Series "S09" carries 560-lb. load with iron-core rubber tread wheel; 1000 lbs with 8" dia. semi-steel wheel. "Floating-Hub" action.

Not one caster failure in six years

These 12-truck warehouse trains at the Philadelphia Naval Aviation Supply Depot have been running on "Floating-Hub" casters since 1948.

In these 6 years not one caster has failed. That's typical of the service these casters deliver.

Complete load protection on every trip

Since 1948, "Floating-Hub" casters have prevented damage to N.A.S.D. cargoes. Accurate tracking through sharp turns is now provided.

Big savings

Prior to 1948, extra riders were required to replace fallen parcels. Today, only one man is needed — to drive. In addition, "Floating-Hub" casters do no harm to road and area surfaces — eliminating previous repair expenses.

Get the facts

Your Bassick industrial distributor has all the facts on the most complete line of shock-absorbing and conventional casters. He can give you valuable help in putting Bassick casters to work in your plant. You'll get fast service from him on all your requirements. Or write Bassick direct.

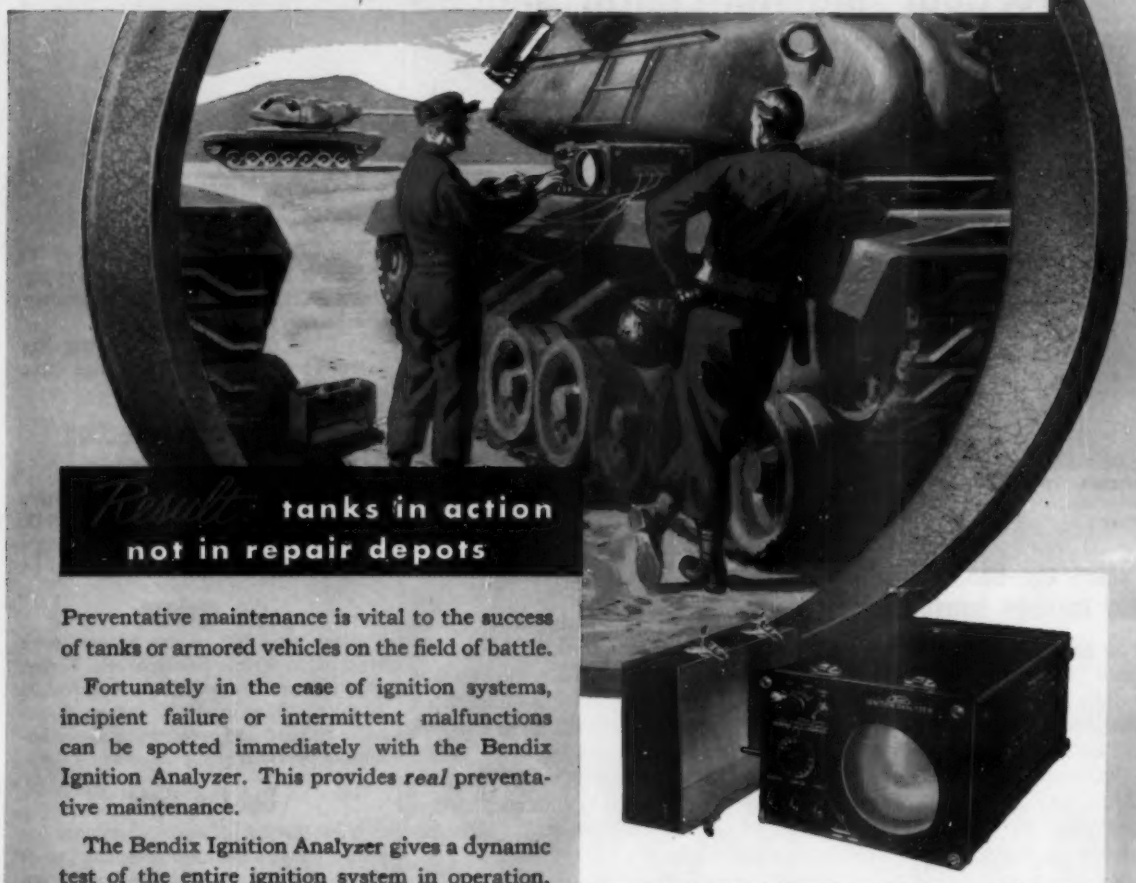
THE BASSICK COMPANY
Bridgeport 2, Conn.
In Canada:
Belleville, Ont.

Bassick
A DIVISION OF
STEWART SW WARNER
MAKING MORE KINDS OF CASTERS ... MAKING CASTERS DO MORE

75 YEARS OF CASTER LEADERSHIP

the BENDIX IGNITION ANALYZER

the only way to make a COMPLETE, POSITIVE, DYNAMIC check of the ENTIRE Ignition System . . . without removing the engine



Result — tanks in action not in repair depots

Preventative maintenance is vital to the success of tanks or armored vehicles on the field of battle.

Fortunately in the case of ignition systems, incipient failure or intermittent malfunctions can be spotted immediately with the Bendix Ignition Analyzer. This provides *real* preventative maintenance.

The Bendix Ignition Analyzer gives a dynamic test of the entire ignition system in operation, outmoding time-consuming static testing of individual components. It is the easiest (checks the entire ignition system in the *field*) and the fastest (locates *any* ignition fault immediately) method of preventative maintenance ever devised for checking ignition efficiency in military vehicles of all types.

Descriptive folder available on request.

Here's How It Works —

The Bendix Ignition Analyzer provides a visual picture of the *actual* voltage waveform patterns occuring at the spark plugs. Normal ignition produces a characteristic normal waveform pattern. Likewise *any* abnormal ignition condition will produce its characteristic abnormal pattern. Interpretation of the patterns identifies and locates any ignition troubles immediately.

Bendix

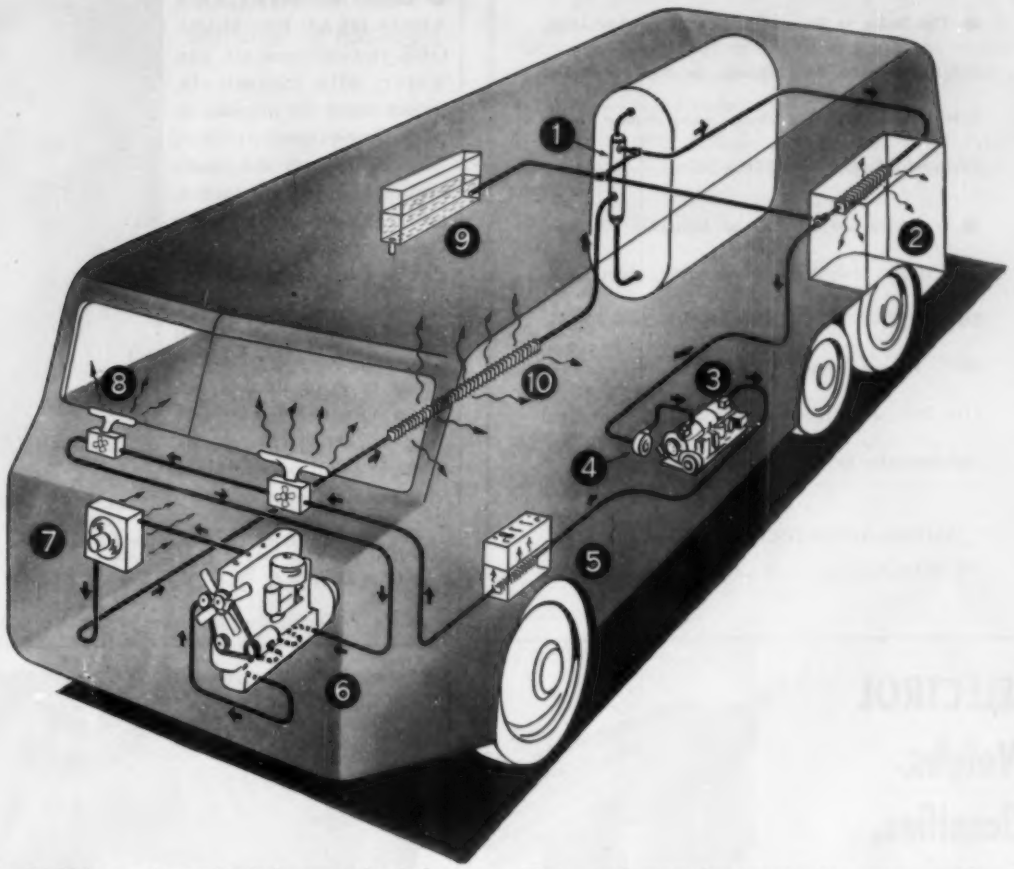
The Bendix Ignition Analyzer safeguards ignition systems in all types of military equipment.

SCINTILLA DIVISION OF Bendix
SIDNEY, NEW YORK
AVIATION CORPORATION

Export Sales: Bendix International Division, 205 East 42nd St., New York 17, N. Y.

FACTORY BRANCH OFFICES: **117 E. Providencia Avenue, Burbank, California • Stephenson Building, 6560 Cass Avenue, Detroit 2, Michigan • 512 West Ave., Jenkintown, Pennsylvania • Brouwer Building, 176 W. Wisconsin Ave., Milwaukee, Wisconsin • 8401 Cedar Springs Road, Dallas 19, Texas American Building, 4 South Main Street, Dayton 2, Ohio**

HOW TO KEEP VEHICLES "hot on the trail"



1. *Liquid-to-liquid heat exchanger for fuels, water, chemicals that might freeze.*
2. *Heat exchangers in special compartments.*
3. *Heart of the system — Janitrol Liquid Heater.*
4. *Liquid circulating pump.*
5. *Heat exchanger in battery compartment.*
6. *Circulation of heated liquid through crankcase and water jackets of engine. (Preheating, standby and maintenance of temperature throughout heating system.)*
7. *Liquid-to-air heat transfer for personnel comfort — cab heating.*
8. *Liquid-to-air heat exchanger coils for defrosting.*
9. *Surge tank. Vent lines from high points in system connect to surge tank.*
10. *Exchanger for cargo, passenger or miscellaneous heating requirements.*

First — and most important — toss your problem into a competent lap! And that means call in Janitrol. Janitrol's experience in applying *liquid* heaters to vehicle heating problems is the culmination of thousands of successful installations on military and commercial vehicles *in operation* all over the world.

The composite drawing illustrates typical elements of Janitrol vehicle heating systems. Any or all of these needs are met by dependable Janitrol Liquid Heaters—regardless of the weather outside.

But remember the first point, and get in touch with Janitrol preferably during vehicle design stage. And for best results on existing vehicles, Janitrol does the job easier with runs of tubing, and compact heat exchangers.

HEAT WHEREVER YOU WANT IT

Janitrol®

AIRCRAFT-AUTOMOTIVE DIVISION, SURFACE COMBUSTION CORP., COLUMBUS 16, OHIO

National Sales, Engineering, Production Headquarters, 400 Dublin Ave., Columbus 16, Ohio. District Engineering Offices: New York, 225 Broadway; Washington, D. C., 4650 East-West Highway; Kansas City, 2201 Grand Ave.; Ft. Worth, 2509 West Berry St.; Hollywood, Calif., 7046 Hollywood Blvd.; Columbus, Ohio, 400 Dublin Ave. Executive Offices: 2375 Burr St., Toledo 1, Ohio.

INDEX TO ORDNANCE

VOLUME XXXVIII

● The Index to Volume XXXVIII of ORDNANCE, with title page for binding, is now available. It will be sent free of charge upon request to the Editorial Offices at the address below.

● It covers subjects in the following 1953 and 1954 issues: July-August (No. 199); September-October (No. 200); November-December (No. 201); January-February (No. 202); March-April (No. 203); and May-June (No. 204). It is arranged alphabetically by subject and author.

AMERICAN ORDNANCE ASSOCIATION

708 Mills Building • Washington 6, D. C.

YOU GET TRUSTWORTHY LIQUID or GAS COOLING Plus Great Water Saving

● With the NIAGARA AERO HEAT EXCHANGER you can cool air, gas, water, oils, chemicals, jacket water for engines or process equipment. You get lower costs and really accurate control of temperature. You have a closed system of cooling, free from dirt and maintenance troubles.

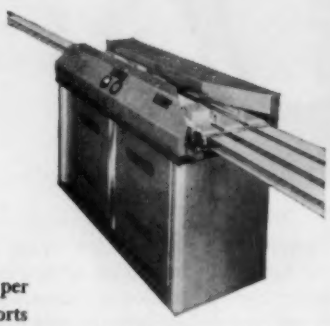
The Niagara Aero Heat Exchanger uses atmospheric air to cool liquids and gases. Great saving in cooling water, piping and pumping and power return the cost to you quickly.

Write for Bulletin No. 120

NIAGARA BLOWER COMPANY

Dept. O, 405 Lexington Ave., New York 17, N. Y.

SELECTROL Weighs, Classifies, and Sorts



At a speed of 100 units per minute, SELECTROL sorts products into three groups: under-weight, over-weight, and correct weight. Correct weights proceed to the next operation. Over-weights and under-weights are diverted for correction. Widely used in civilian industry for precision checkweighing and inspection by weight, SELECTROL is ideally suited to arsenal use as well. SELECTROL checkweighs 20-millimeter loaded shells to a rejection-point tolerance of five grains, plus or minus. Write for details.

Exact Weight Scales

Better quality control

Better cost control

THE EXACT WEIGHT SCALE COMPANY

900 W. Fifth Avenue, Columbus 8, Ohio

2920 Bloor St., W., Toronto 18, Canada

Fuller Gun Brushes On Active Duty

We are proud to be serving our Armed Forces with gun brushes. These brushes usually are available for an extra tour of duty because of their unique Fullergript construction. In this construction a tripled mass of brush material is loop-anchored inside a rigid metal backbone to provide a far denser brushing surface and extra long brush life.

INDUSTRIAL Fuller BRUSH CO. DIVISION

3585 MAIN STREET - HARTFORD 2, CONNECTICUT

Power driven brushes, Factory & Institutional cleaning tools, Waxes & Detergents

ABBOTT the BALL with the ARMORED HEART!

Quality is more than "skin deep" in Abbott Balls.

Cold forged from special carbon steel wire, every Abbott Ball is DEEP HARDENED to provide a *thick* armored shell for the soft, resilient heart of the ball. This makes Abbott Balls crush resistant and more efficient under high load factors.

Every Abbott Ball is TEMPERED to insure scientific control of the steel grain structure within the ball. Tempering adds stability and shock resistance—relieves stresses—prevents sphericity and size distortion.

For shock resistance and efficient performance PLUS uniformity in size . . . Specify ABBOTT—the BALL with the Armored Heart!

THE ABBOTT BALL COMPANY
70 RAILROAD PLACE
HARTFORD 10, CONN., U.S.A.

ABBOTT

Cork-and-Rubber Gasket Materials

Armstrong manufactures cork-and-rubber gasket materials made to meet each class of the principal government specifications covering cork-and-rubber gasket materials.

Specification	Material
MIL-G-6183	
Type I Soft	NC-709
Type I Medium	NC-710
Type I Firm	NC-711
MIL-T-6841	(DK-153 (RK-5045
Type II Soft	DC-167
Type II Medium	DC-100
Type II Firm	DC-113
MIL-G-6747	DK-149

Write for samples and 24-page gasket design manual.

ARMSTRONG CORK COMPANY
2905 Arch St., Lancaster, Pennsylvania

Keep the A.O.A. growing!

You can help a lot . . .

Simply write in the names and addresses of friends you think should belong to the Ordnance Association and return this form to National Headquarters.

We will send to each person listed, who is not already a member, a special membership invitation telling him about the aims, purposes, and services of the A.O.A.

Please Print

Name_____
Address_____
City, Zone, State_____
Name_____
Address_____
City, Zone, State_____
Name_____
Address_____
City, Zone, State_____
Name_____
Address_____
City, Zone, State_____
Name_____
Address_____
City, Zone, State_____

●

Please print *your* name and address here so that you and your Post will get credit for the memberships obtained.

_____ *Your Name*

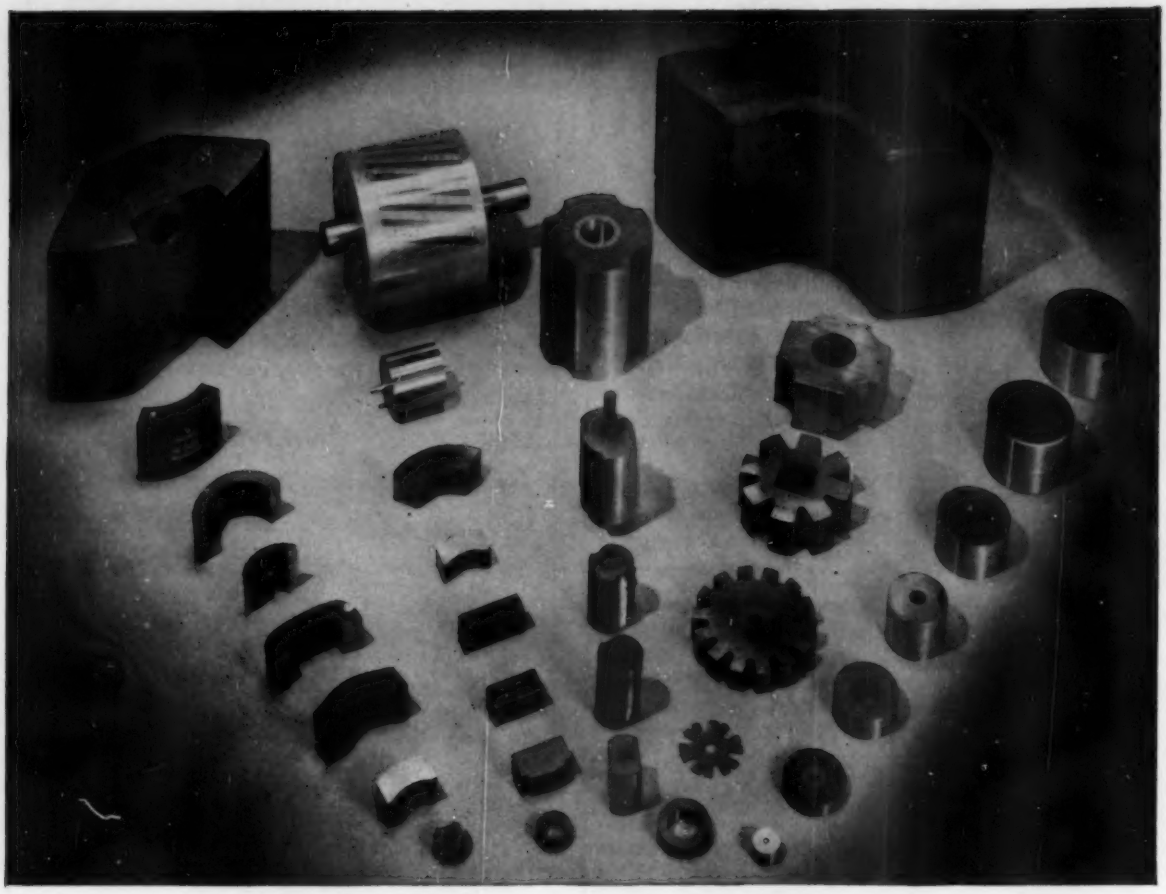
_____ *Address*

When we write your friends we can mention your name or not, as you prefer:

CHECK ONE: ☐ please mention my name
☐ do not mention my name

Return to:

AMERICAN ORDNANCE ASSOCIATION
708 Mills Building ● Washington 6, D.C.



Magnets for rotors or stators ...any design or size you may require

"MAGNETIC MATERIALS CATALOG"

Write for your copy

Contains handy data on various types of Alnico Magnets, partial lists of stock items, and information on other permanent magnet materials. Also includes valuable technical data on Arnold tape-wound cores, powder cores, and types "C" and "E" split cores in various tape gauges and core sizes.

ADDRESS DEPT. O

The use of Alnico permanent magnets in rotor and stator assemblies of motors, generators, magnetoes and tachometers has revolutionized the designs of these devices. Whatever your need may be —from a tiny rotor for a timing device to a large slab for power generators—Arnold can take care of your requirements, either for experimental samples or production quantities.

● *Let us work with you.* You will have the advantage of working with a leading producer of rotor magnets, whose manufacturing and testing facilities—the most modern in the business—give you the best assurance of high quality standards and uniform performance.

WADS184

THE ARNOLD ENGINEERING COMPANY

SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION

General Office & Plant: Marengo, Illinois

DISTRICT SALES OFFICES . . . New York: 350 Fifth Ave.

Los Angeles: 3450 Wilshire Blvd. Boston: 200 Berkeley St.

ARMAMENT TECHNOLOGY

This section of ORDNANCE contains articles of a detailed and technical nature on ordnance research, development, manufacture, field use, and related subjects.

Dynamics of Air Warfare

We must be able to destroy enemy air power on the ground

Brig. Gen. L. I. Davis

Director of Development, Air Research and Development Command, Baltimore, Md.

OUR national policy is designed to secure peace. However, should war come, the United States Air Force has a tremendous responsibility to bring it to a successful conclusion as quickly and efficiently as possible. While we hope that World War III never comes, we realize that success in war depends upon careful planning. In turn, our planning must be done in the light of an appreciation of the nature of the next war.

There is one aspect of that appreciation which appears to be very important. Nuclear weapons have placed in the hands of the military so much destructive power that, combined with the speed and flexibility of the airplane, operations are speeded up many times. The extent of that speed-up and its effect on the nature of the next major war are worthy of careful study.

I wish to touch lightly on one of the fundamental aspects of the problem. If I approach it semitheoretically, it is because I believe the step between World War II and some future war is more than a simple extrapolation. As Secretary Finletter once said: "The next war will be as unlike World War II as World War II was unlike Agincourt." Let us look at some of the conditions.

The modern bomber can carry a load a *million times* more powerful than that carried to Berlin by the B-17 of World War II.

The magnitude of the change in terms of total power is so great that we sometimes let our thinking stop with total effects alone. The fact that we can destroy a group of targets or a nation's industry many times over should not blind us to consideration of the *rate* at which these targets can be destroyed. Unless we look at all aspects of the employment of these new weapons we may fail to exploit all aspects of their power—may even make dangerous mistakes in strategy. Even more important, the nation may err in its choice of major weapons systems.

PART of our appreciation of these new weapons must be recognition of the increased rate of delivery of destructive power. It is obvious that, if one bomber can deliver a million times the equivalent tonnage in one trip, a group of bombers can accomplish in hours the total destruction which took years to inflict on Germany in World War II.

It is this matter of *rate* of doing damage that must be considered. As our stockpile (and our enemy's stockpile) grows, the dynamics of the engagement becomes more important than the total lethality of the stockpile.

CONTENTS

ARMAMENT TECHNOLOGY SECTION

Dynamics of Air Warfare 153
Brig. Gen. L. I. Davis

Air Power and Research 157
Col. Philip S. Robbins

Aircraft Armament 160
Col. Robert T. Fincke

Aërial Fire Control 162
Col. Leroy L. Stefen

Packaging in Modern War 164
Col. James N. Sammons

Fatigue Testing Machine 166
David E. Driscoll

A homely analogy may illustrate my point. Two men are dueling at twenty paces. One has a caliber .45 pistol, the other a caliber .38. Which size bullet is the more lethal is academic. Who shoots *first* and how *accurately* and *more rapidly* is more to the point.

Popular concepts of the rôle of strategic air power are illustrated by the air war against Germany and Japan. There the main target was industry, and the enemy's military forces were, in the end, rendered impotent by destruction of plants, transportation, and bases.

This, however, was a slow process. Targets could be rebuilt almost as fast as TNT bombs could destroy them. In addition, supplies on hand cushioned the impact of destruction of plants, and substitute or alternate sources of material were soon found. Strikes at ball-bearing factories and at industries deep in the substructure of industry illustrate this effect.

So, in World War II we saw these dynamic effects: First, the *rate* of destruction was approached by the *rate* of rebuilding; secondly, there was quite a lag between destruction of a segment of industry and its effect on the military force in being. A third and very important fact was that while we were inflicting damage on the enemy's bases and industry our own air bases and industry were out of the enemy's reach and so could operate at full blast at all times.

IN World War III the situation will be quite different:

1. The rate of destruction of air power itself by enemy action will be many times the rate of replacement by industry.

2. The rate of destruction of industrial capacity will be many times the rate at which industry can be rebuilt.

3. Our own industry and air bases for the first time in history will be subject to heavy attack.

These three considerations bring us to a truly new pattern of warfare.

The third point—vulnerability of our own industry and bases—is especially important because we will have a situation in which *each side* can hit the force in being as well as the industry that builds it.

Whenever this condition exists, the results become more sensitive to the

This paper was presented by General Davis at the Thirty-sixth Annual Meeting of the American Ordnance Association, Fort Worth, Tex., May 6, 1954

rates involved, and estimating the effect of these factors becomes increasingly complicated. It introduces a form of "feedback" that emphasizes the importance of winning air supremacy first, and, when one side gains the ascendancy, it tips the scales and accelerates the debacle.

To study the nature of the next war, and how its operations will be affected by our new weapons, is a monumental task. The tremendous increase in the power of the forces in being is one factor, and, every one will admit, the most important one. There are many other factors: the size and composition of forces, the performance of our aircraft and missiles, the distances to be traveled, the state of training of crews, and other factors too numerous to be mentioned.

We can study the last war and try to project and extrapolate into the future—or we can just opine and argue. However we approach the problem, it deserves our best thought, our most energetic endeavor, and the use of any and all tools available to military planning.

One of the tools available is the procedure of making a model, or analogue, which attempts to show the relation and function of the major factors. On the basis of these relationships, assumptions are made and the operation of the model is studied by the use of mathematics or by the construction of simulators or electronic analogues.

The simplest model of two nations engaged in air atomic warfare can be diagramed as shown in Figure 1. Suppose we have two equal quantities, Q_a and Q_b, each capable of destroying the other. Each quantity is supplied or replaced by sources P_a and P_b.

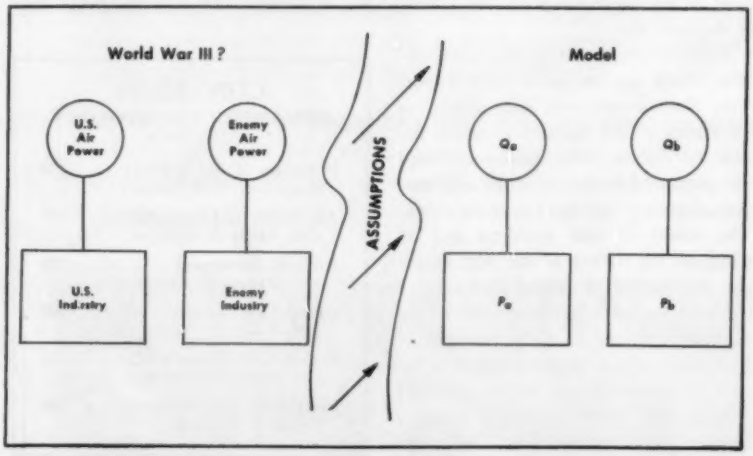
The model is symmetrical; that is, the two sides are alike, as in a chess game. Q_a can be applied against Q_b or against P_b, or both. Similarly, Q_b can be applied against Q_a and P_a. We are interested in finding the best division of Q_a as it is applied against Q_b, the simulated enemy force in being, or against P_b, the simulated enemy industry.

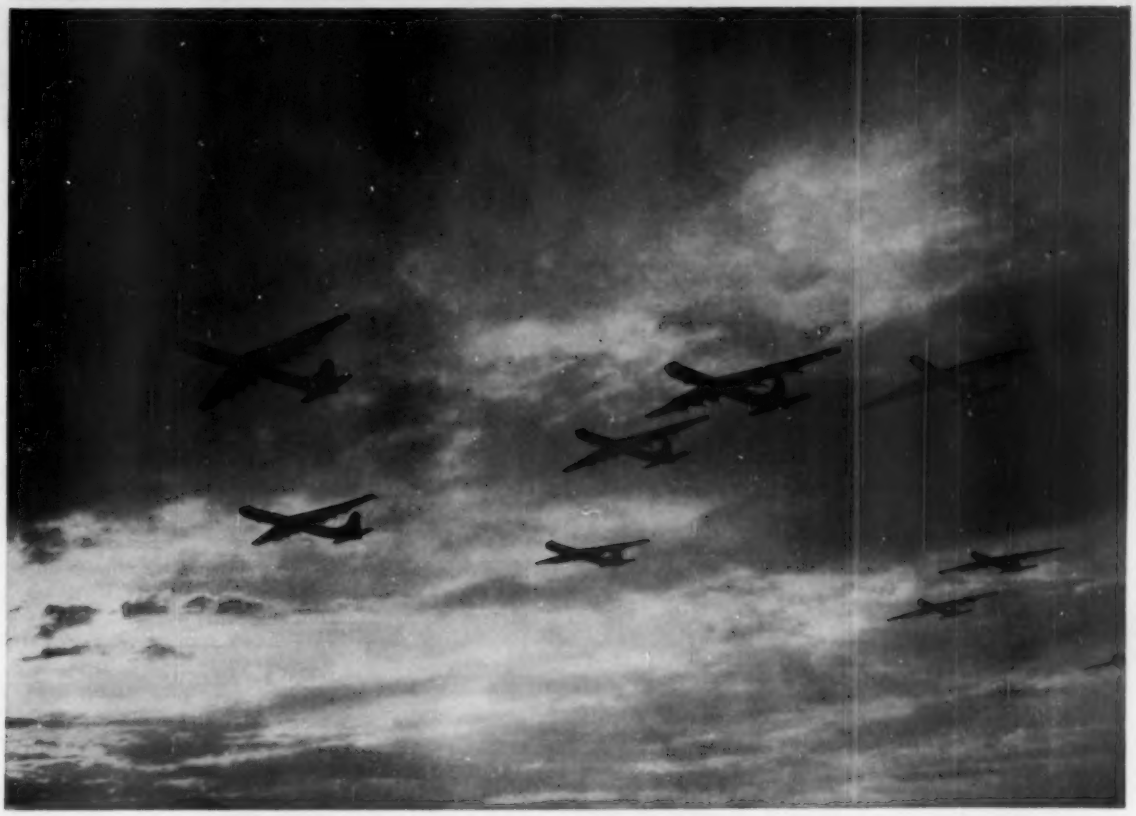
BEFORE we go too far, let's carefully differentiate between the model we fashion, which we can define precisely, and the real situation which pertains to some future war and is undefinable in exact terms.

Figure 1 is drawn to remind us that there is a great chasm between reality and the model. The characteristics of our air power and our industry are described by innumerable factors, and many assumptions are involved in bridging the gap from reality to something which attempts to describe an equivalent capability in terms of end effects.

A symmetrical model is used to highlight considerations that might be overlooked if one side had a preponderance of strength or capability. Since

Fig. 1. A simple diagram model of two nations engaged in air atomic warfare.





A formation of Convair B-36 long-range bombers on practice maneuvers (Air Force photo).

this device is of our creation, we can define it precisely and with terms that permit manipulation to determine the response of the system as factors are varied. It remains for us to use our judgment as to whether or not it is representative of conditions that might pertain to World War III.

In this analogy, Q is the potential (air strength) at any time during the course of the "war." P is the capacity of "industry" to replace Q. When war starts, Q_o the initial value of the air forces, is at a level that is 400 times the production rate, P_o, at the start of the war. In other words, if we have 4,000 units of air power at the start we are producing 10 units a day.

THE subscripts, a and b, refer to friendly and enemy forces, respectively. The dynamics of the exchange are represented in the model by the time it takes one force to destroy the other. In this model we assume that the rate of destruction is proportional to the strength of the "attacker"—and also to the size of the thing being attacked.

In other words, if we apply all of Q_a against Q_b we will reduce Q_b exponentially to about one-third its value in some time T. This value of time is the characteristic that measures the rate of destruction assumed in the model. T_{ab} is the characteristic time that describes the rate of destruction Q_a can apply to Q_b. Similarly, T_{ap} is a measure of how fast Q_a can destroy P_b. Q_a can "attack" either Q_b or, if it divides its attack, can apply a fraction (a) against Q_b and (1-a) against P_b. Similarly, Q_a is applied (b) to Q_a and (1-b) to P_a.

This model can be more accurately defined by differential equations (Fig. 2). The response of the two systems when placed in opposition can be studied by assuming initial conditions and varying parameters such as (a) and (b). Since the equations are nonlinear, an explicit solution cannot be written, but electronic computers are available which will accept the problem in its differential form and plot values of the quantities against time.

A series of engagements in which a and b are varied between 0.1 and 0.9 are presented in Figure 3. For this purpose, the success of a strategy is assigned a value corresponding to the maximum reduction of the production rate of friendly industry.

What are the results of these studies? The first and most obvious lesson is that good strategy requires that the enemy potential in being must receive the major portion of the "attack." If the attack is distributed in a manner to reduce the two types of targets at the same rate—or proportional to the effort required for their total destruction—the "enemy" can win by devoting a larger share of his force to the destruction of our potential in being.

THE lesson is, of course, the oft-repeated Air Force's doctrine of winning the air battle first—by destroying the enemy's air force in the air or on the ground.

The second inference is related to the first and is illustrated in the values

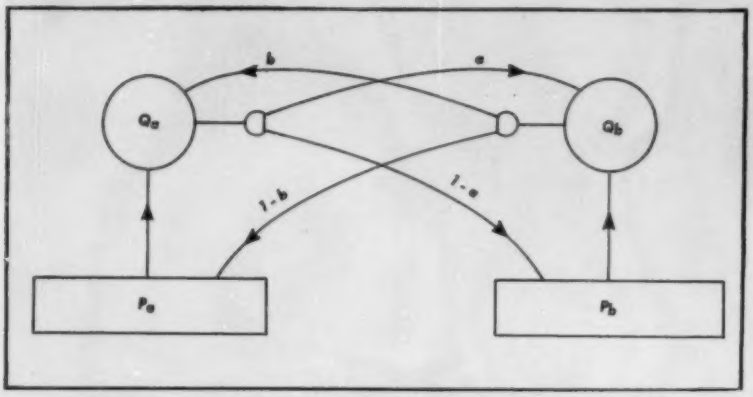


Fig. 2. The effect of the application of air power defined by equations:

$$\frac{d}{d+} Q_a = P_a - \frac{b}{T_{ba}} Q_b \frac{Q_a}{Q_{ao}}$$

$$\frac{d}{d+} Q_b = P_b - \frac{a}{T_{ab}} Q_a \frac{Q_b}{Q_{bo}}$$

$$\frac{d}{d+} P_a = \frac{(P_{ao} - P_a)^*}{T_{ra}} - (1 - b) \frac{Q_b}{T_{bp}} \frac{P_a}{P_{ao}}$$

$$\frac{d}{d+} P_b = \frac{(P_{bo} - P_b)^*}{T_{rb}} - (1 - a) \frac{Q_b}{T_{ap}} \frac{P_b}{P_{bo}}$$

Typical values:

$Q_{ao} = Q_{bo} = 400 \times P_{ao} = 400 \times P_{bo}$
$T_{ab} = T_{ba} = 20 \quad T_{ap} = T_{bp} = 40$
$T_{ra} = T_{rb} = 360 \quad a, b,$ variable

*Terms to provide recovery of P

charted in Figure 3. As the two contestants devote more and more of their effort against each others' "force in being," the winners' industry absorbs less punishment.

The model has not treated explicitly with the problem of intelligence. Nor has it assumed one hundred per cent knowledge of enemy targets. The assumption of an ability to destroy two-thirds of the enemy force in being in twenty days—and two-thirds of the remainder in the next twenty days—allows for an expansion of the known target system after initiation of hostilities.

This model has not treated with defensive forces explicitly. The destruction of the enemy air force can be done by our interceptors over our cities, or by our Strategic Air Force bombing enemy air bases. However it is done, destruction of the enemy's long-range striking force must be our first objective.

Nuclear weapons have changed the nature of war in many ways. The total destructive power available is almost beyond comprehension—certainly enough to destroy all the world's industries many times.

However, the next war may not necessarily be won by the nation that has the greatest stockpile of atomic weapons. The rapid delivery of these weapons against enemy air power and the protection of our air power against destruction is the key to survival.

OUR stockpile of bombs must be complemented by an Air Force in being, ready to go at a maximum delivery rate. It must be dispersed and protected so that if we *must* suffer another Pearl Harbor we can get up off the floor and retaliate with the speed and accuracy that will win.

Editor's Note.—This and the four following papers were delivered at the Aircraft Armament Session of the Thirty-sixth Annual Meeting of the American Ordnance Association, held at the Texas Hotel, Fort Worth, Tex., on May 6, 1954.

At the Titanium Seminar on the same day, four outstanding papers were presented on the use of titanium in the Air Force program. These papers are being published as a Special Report to the Company Members of the American Ordnance Association.

X	.1	.2	.3	.4	.5	.6	.7	.8	.9
.1	X	82	75	66	60	54	46	38	32
.2		X	71	63	57	51	44	36	29
.3			X	60	53	48	42	33	27
.4				X	50	44	(38)	30	25
.5	B wins				X	40	34	27	23
.6	(Values same as mirror image)					X	30	24	20
.7							X	21	18
.8								X	16
.9	32	29	27	25	23	20	18	16	X

A wins

Fig. 3. Results of various games of the family: $T_{ab} = 40$, $T_{ap} = 80$, $T_{rp} = 360$, $Q_o - 400\ P_o$

Parameters a and b varied from .1 to .9. Tabulated values are the maximum reduction of production capacity of the winning side expressed in percentages. For example: The value (38) under the column headed .7 and in the row .4 refers to a "game" in which Q_a was applied 70 per cent against Q_b and 30 per cent against P_b, while Q_b was applied 40 per cent against Q_a and 60 per cent against P_a. The maximum reduction of the production rate, P_a, was 38 per cent.

Air Power and Research

The basic mission of the Air Research and Development Command is the task of assuring and maintaining the qualitative superiority of the equipment and matériel of the United States Air Force

Col. Philip S. Robbins, U.S.A.F.

THE mission of the Air Research and Development Command is a reasonably simple one to state. It is to: (1) Attain and maintain qualitative superiority of matériel; (2) Seek new basic knowledge from which improved aëronautical equipment, weapons, and techniques can be developed; (3) Undertake the development of appropriate new and improved devices and systems for the conduct and support of air warfare.

In short, the Command mission is to assure the qualitative superiority of the equipment and matériel of the United States Air Force.

From whence came this organization now charged with this quite sophisticated task? In a large measure it was conceived from the experiences of the last World War.

Among the many lessons totted up at the end of that conflict was the one that the enemy had not taken a technological vacation by any means during our struggle with him. His advances in jet propulsion and guided missiles are well remembered. It was clear that we could not again run any risk in being second in any technical race.

THAT conflict, and technical events following shortly, also mirrored the increasing magnitude and complexity of the research and development task that would have to be accomplished if we were to retain that essential technical leadership.

In the light of these problems, the Chief of Staff in 1949 requested the Scientific Advisory Board of the Air Force to appoint a special committee to survey the Air Force research and development program and to make recommendations on the proper emphasis, organization, and management of that program.

Colonel Robbins is Executive for Technical Operations, Air Research and Development Command, Baltimore, Md. This article is taken from a speech given by Colonel Robbins at the Thirty-sixth Annual Meeting of the American Ordnance Association held in Fort Worth, Tex., recently.

The committee report, submitted later that year, indicated a need for focusing and coördinating the increasingly diverse activities in the research and development fields, a need for emphasizing those activities, and a need, to a practical extent, for making certain that the demands of the present did not overshadow the work essential to the future superiority of Air Force weapons and matériel.

An Air University report, made separately at about this same time, contained similar conclusions. Both reports recommended, in part, the establishment of a separate major command to carry out the research and development program of the Air Force.

Acting on the recommendation of these reports, Gen. Hoyt S. Vandenberg authorized the activation of the Air Research and Development Command in February 1950, and, after a period of organizing and staffing, ARDC emerged as an independent major command on April 2, 1951.

Working closely with industry, science, and other governmental agencies to insure maximum utilization of available scientific and technical resources, ARDC applies its full effort to the research and development program. Its basic rôle is to plan and direct a sound realistic program—defining and outlining the problems to be solved to meet the terms of immediate and long-range Air Force requirements, contracting with industry and civilian research organizations for the research and development required to solve the problems, monitoring their work, and evaluating and testing their results.

INDICATIVE of this close collaboration is the fact that 86 per cent of ARDC's total research and development funds in 1953 were spent for work by non-Air Force agencies on research and development contracts. Included were approximately 170 universities, colleges, and other nonprofit organizations and 1,360 industrial organizations.

The focal point of this coördinated research and development effort by the Air Force, science, and industry is the Air Research and Development Command headquarters in Baltimore, Md. In the organization of ARDC headquarters there are special staff offices

normal to a military organization, such as the chaplain, information services, the staff judge advocate, the inspector general, the adjutant, and the surgeon.

There are also two special staff offices whose responsibilities one might not consider "normal." The first of these is the Office of the Assistant for Operational Readiness. This office advises the commander of ARDC of Air Force progress toward operational readiness and assists the deputy commander for technical operations in insuring that research and development programs are integrated with approved major Air Command requirements.

THIS office keeps in constant touch with the using commands, finding out their needs, difficulties, and desires, and keeping those commands informed on equipment and matériel in the process of development.

The second of these special staff offices is the Office of Atomic Energy whose responsibility is to expedite, coordinate, and guide ARDC operations in connection with atomic weapons.

The bulk of activity carried on within the headquarters falls within the offices of the two deputy commanders. The deputy commander for support operations is Brig. Gen. Kurt Landon. General Landon supports the technical mission of the Command and manages, from a headquarters staff level, the support activities at the centers through the Command.

Under the Deputy Commander for Support Operations we have the comptroller, the directorate of personnel, the directorate of installations, the directorate of procurement, the directorate of maintenance supply and communications, and the directorate of manpower and organization.

The deputy commander for technical operations is Brig. Gen. Floyd B. Wood who is responsible for managing the research and development program. Included under technical operations is the directorate of research which includes the office of scientific research, the geophysics division, and the human factors division.

Next we have the directorate of development, responsible for development in the technical areas such as radar and communication, guidance and control, air munitions, aëronautics and propulsion, atomic operations, and equipment. Brig. Gen. L. I. Davis is the director of development.

Next is the directorate of weapon systems. This office is responsible for planning, coördinating requirements, establishing appropriate weapon development programs, and, through the various centers, the development of complete weapons systems, including the weapon itself and all supporting equipment necessary to produce a combat-ready system.

Next is the directorate of operations whose activities include test operations, the standardization program, facilities planning, the allocation of test aircraft, and air operations.

Ten major research, development, and test centers located throughout the country are maintained and directed by ARDC headquarters to accomplish its mission in the fields of research and development, including test and evaluation functions.

In the Boston area, the Air Force Cambridge Research Center at Cambridge and Bedford, Mass., conducts a broad program of research with some development and testing in electronics, geophysics, radiobiology, radiochemistry, and a few phases of nuclear physics to establish and prove fundamental principles in these fields and to advance their military applications.

The center further provides active Air Force participation and support to a special Army-Navy-Air Force project encompassing all aspects of the Nation's air-defense problem.

Volscan, the automatic computation and control system which solved the air traffic control phase of return to base, is a product resulting from the research and development at this center.

THE Rome Air Development Center at Griffis Air Force Base, Rome, N. Y., conducts research and development, including tests, of ground-base and certain airborne electronic systems, such as detection, control, identification, countermeasures, navigation, communications, data-transmission systems, and related automatic flight equipment.

This center also accomplished research and development on systems to further Air Force intelligence and reconnaissance missions.

The turntable radar set was recently developed at this center. This turntable enables an air base to provide ground-controlled-approach facilities on multiple runways in both directions with only one radar set and from a single site.

The Wright Air Development Center at Wright-Patterson Air Force Base, Dayton, Ohio, is one of the world's most extensive and completely equipped facilities devoted to aëronautical advancement.

The center's comprehensive program embraces research and development, including testing of aircraft, guided missiles, power plants, propellers, armament, materials, ground and airborne equipment, aëro medicine, aërial photography, and airborne electronics.

The detailed management and evaluation of a large proportion of our contractual work lies within this center and its laboratories.

THE Arnold Engineering Development Center under construction at Tullahoma, Tenn., will provide ultra-modern facilities for testing and evaluating supersonic aircraft, guided missles, and aircraft engines of all types under simulated free-flight conditions.

The first completed testing unit of the gas dynamics facility at the center will be "Tunnel E-1," a 12-inch supersonic tunnel which will be capable of testing aircraft and missiles operating at speeds ranging from 1,000 to 3,500 miles an hour.

The Air Force Personnel and Training Research Center with headquarters at Lackland Air Force Base, San Antonio, Tex., conducts scientific research programs on the selection, classification, assignment, proficiency evaluation, and training of airmen and officer personnel as well as of crews and teams of individuals, involved in Air Force ground and air operations. The center maintains research laboratories at eight Air Force bases located throughout the country.

The Air Force Flight Test Center at Edwards Air Force Base, Edwards, Calif., flight tests aircraft and components as complete vehicles and conducts research and development on testing procedures. The center also maintains the USAF Experimental Flight Test Pilot School at Edwards and the USAF parachute test group at El Centro, Calif.

The X-1A—an aircraft tested at this center—was flown by Maj. "Chuck"

Yeager at more than 1,600 miles an hour. Tests of personnel and cargo parachutes are also conducted at this center.

The Air Force Special Weapons Center at Kirtland Air Force Base, Albuquerque, N. Mex., carries out the Air Force's responsibilities in the development and testing of atomic and other special weapons, their components, and associated equipment.

The Holloman Air Development Center at Holloman Air Force Base, Alamogordo, N. Mex., conducts tests and research and development related to tests on pilotless aircraft, guided missiles, and allied equipment. The center also conducts research and development in space biology; supports research programs in guided missiles, electronics, atmospherics, physiology, and psychology; and provides facilities for contractors and other Government agencies to conduct research and development operations.

The Aërobee rocket—using live mice and monkeys as passengers, was fired from this center. Rocket slide tests on a high-speed track are carried on here to study the problems of escape and the effects of deceleration at supersonic speeds.

The Air Force Armament Center at Eglin Air Force Base, Fla., tests aircraft-armament systems and components, including guns, ammunition, bombs, and rockets. The center also conducts research and development on test procedures.

THE M39 20-mm. automatic gun, having a considerably higher rate of fire than any aircraft gun now in operation and which was recently developed by industry, the Army and the Air Force, was tested here.

The Air Force Missile Test Center at Patrick Air Force Base, Cocoa, Fla., tests long-range guided missiles and target drones over its more than one thousand miles of proving grounds stretching from Cape Canaveral, Fla., to a point off the coast of Puerto Rico. This center also accomplishes research and development on testing procedures. The Matador test, of which you have heard, was conducted here.

The picture to this point has been of the head and body of the organization. Now let us consider a brief sketch of one of its arms, the Air Force Development Field organization. This organization consists of some twenty-four field offices located throughout the United States at major research and development installations of the Army, Navy, and National Advisory Committee for Aëronautics, and in some of the major industrial areas.

"Working closely with industry, science, and other governmental agencies to insure maximum utilization of available scientific and technical resources, ARDC applies its full effort to the research and development program. Its basic rôle is to plan and direct a sound realistic program, defining and outlining the problems to be solved . . . contracting . . . for the research and development required, monitoring the work, and evaluating and testing standards."

The mission of this organization is to provide technical liaison between ARDC and those installations and to provide technical services to current or prospective contractors.

There are offices at each of the NACA laboratories (Langley, Lewis, and Ames), at Army installations such as Aberdeen, Bragg, and Belvoir, and at Navy installations such as the Naval Ordnance Test Station, the Naval Air Test Center, Naval Special Devices Center and others.

These offices total twenty-one, and they monitor not only Air Force contracts but also other work of interest to the Air Force being conducted at the specific host installation.

These offices assist our contractors and our laboratories in planning tests to be conducted at these installations, coördinating the activities of contractor and ARDC laboratory personnel participating in the test or other work, and in providing a ready channel of information between host installation, laboratory, and contractor.

While these twenty-one offices are located as they are primarily for purposes relating to the activities of the host installation, they are also charged with rendering technical services to current or prospective contractors in that area. For instance, the development field office at Boston was established basically because of large-scale Air Force work being performed at M.I.T.; however that office also serves contractors in the central New England area.

The remaining three of the twenty-four development field offices are located in New York, Los Angeles, and Seattle. Offices were established in these three cities because the major portion of our research and development contract activity dollarwise is in those three industrial areas. These offices are primarily concerned with liaison with industry, rather than other governmental agencies, and they are capable of rendering many services to the Command organization and its associates.

HERE are a few of the services these offices can offer:

In the capacity of consultants, they can provide technical knowledge for the solutions of technical problems or solicit knowledge from other known sources of information.

As advisers, these offices can give prospective contractors full information on Air Force requirements for data on financial and technical capabilities.

They can refer contractors to appropriate experts or specialists or arrange conferences with such individuals.

They can provide contractors with interpretations or explanations of the technical requirements of an exhibit to a research and development contract, or obtain such information.

They can provide preliminary analyses of new ideas or proposals and can directly arrange further evaluation. When such ideas or proposals are not applicable to the Air Force program, guidance to the appropriate Government agency and assistance in locating a qualified contact in that agency can be offered.

In summation, the Air Research and Development Command is the Air Force command charged with assuring the qualitative superiority of the equipment and material of the United States Air Force.

It accomplishes that mission through the organizational media of a planning and managing headquarters, ten centers devoted to various phases of research and development, and appropriate other agencies required to keep the Command in close contact with both its customers and those who serve it so well—industry, science, and education.

Aircraft Armament

New guns, rockets, and bombs are being developed to help solve the pressing problems of firepower and accuracy under the supersonic conditions of today's high-altitude aërial warfare

Col. Robert T. Fincke, U.S.A.F.

THE extensive publicity recently given the atomic and thermonuclear weapons has apparently left the impression with many that the Air Force has practically eliminated its program in other weapons.

This is definitely not the case. Since the Second World War the Air Force has conducted a vigorous research and development program to obtain improved guns, rockets, and bombs, and, although we are placing a high priority on attaining a capability in atomic weapons, we are continuing to support the development and improvement of conventional weapons which complement the "new look."

During the past fifteen years major strides have been made in aircraft performance. Our aircraft are flying higher than 45,000 feet and faster than Mach 1.0 in level flight.

THESE altitudes and speeds were not considered possible when some of our present weapons were first conceived. Consequently, the development of air weapons has been sorely pushed to keep abreast of these rapid advances in aircraft performance.

The pressure to phase weapons into specific aircraft has meant starting production, in some instances, prior to full development and testing. If we are to have an adequately tested weapon available for future aircraft, it is mandatory that our technical program explore new ideas and develop prototypes in anticipation of these future needs.

Colonel Fincke is chief, Air Munitions Division, in the Directorate of Development, Air Research and Development Command, Balitmore, Md. This article is taken from an address given by Colonel Fincke at the Thirty-sixth Annual Meeting of the American Ordnance Association, Fort Worth, Tex., May 6, 1954.

We cannot wait until an airframe is selected to begin work on a new weapon and expect the two to meet in production.

The first step in obtaining a proper research and development program is to determine what is needed and to express this need in the form of military requirements. To accomplish this, the Air Force has established the Directorate of Requirements in Headquarters, U.S.A.F. This group consults with the planners, the developers, the producers, and the users before determining the Air Force requirements.

The military characteristics for a given aërial weapon which would satisfy a requirement are a compromise of what is technically feasible, what is logistically supportable, and what is acceptable to the users.

It is obvious, but not always appreciated, that these characteristics change as the operational framework changes and as the feasibility of new components changes.

In order to tap all available ideas, persons at each echelon of the Air Force are encouraged to forward recommendations for military requirements to the Headquarters. These channels are always open.

The second step in our research and development program is to decide how the requirements can best be met. This decision is the responsibility of the Air Research and Development Command working with the other services and with industry's research and development people.

THE Air Force is cast in the rôle of customer in its relationship with industry. This relationship is a contrast with that of the Army and Navy which are more in the rôle of partners because of their internal capability to develop and produce ordnance end items.

We do not intend to duplicate this "in-house" capability of our sister services but will continue to use their facilities and organizations to the greatest extent possible.

It is also Air Force policy to encourage and support the broad participation of industry in the research and development of air armament equipment. Only by joining the technical know-how of both the military and industrial agencies can we find easier, simpler ways to meet our needs.

Those of you who have accepted contracts for development of air ordnance

appreciate that we always consider the complete system. It is the system which determines the outcome of aërial combat rather than the caliber or rate of fire of the guns.

The measure of a gun, rocket, or bomb to satisfy a requirement cannot be evaluated independently of its effect on the airframe, engines, or other equipment. Nor can it be separated from the aërodynamic forces which make up its environment.

An illustration of this is the caliber .50 machine gun which served us throughout World War II and again in Korea. In 1946 after extensive calculations, the developers concluded that the caliber .50 gun was superior to the 15-mm. and 20-mm. cannon then available.

The conclusion of over-all effectiveness is based on an analysis-type equation which relates effectiveness to: (a) hit probability, (b) rate of fire, (c) destruction per hit, and (d) weight of the complete system. The increased destruction per hit of the cannon was nullified by its slower rate of fire.

AS aircraft speeds increase, the time on target continues to be reduced. In aërial combat the target may be in range for only a fraction of a second at a time and a hit may have to be made during only one pass.

As a consequence, the increase in rate of fire and the increase in lethality of the projectile by enlarging its caliber become more critical. These changes require more and heavier rounds, in turn increasing the weight of the system which penalizes the performance of the airplane.

We can satisfactorily compensate for this increase in weight as illustrated by the M39 gun which was recently standardized. This is a 20-mm. automatic gun employing the revolving-chamber principle and firing an explosive shell at a rate greater than the caliber .50 gun which has been built up to 1,200 rounds a minute.

A few of the M39 guns were tested in Korea and are reported to have accounted for six MIG's destroyed, three probably destroyed, and twelve damaged. This gun was developed for the Air Force by the Army Ordnance Corps in coöperation with industry.

Now that satisfactory larger caliber guns are becoming available, special emphasis is being placed on reliability of their performances, problems associated with aircraft shock and vibration, and the effect of aërodynamic forces on the trajectory of bullets fired at high yaw angles during subsonic and supersonic speeds.

The fundamental problem of reduced time on target has called for a duck-hunter's approach to increase the probability of a hit. We have therefore adopted the shotgun principle of a simultaneous burst of many pellets on the target.

The modern version is a burst of small unguided rockets. These are self-propelled warheads and can be made in almost any size from one to several inches in diameter and with an explosive head weighing from several ounces to several pounds.

Rockets have a built-in reliability. The failure of one round to fire does not cause a stoppage of the weapon. Since each round is carried in a separate tube, only the one faulty round is lost from the total available.

Because the propelling forces act only on the motor walls, there is little recoil and accompanying stress on the firing aircraft. Thus, both the rockets and the launcher installation can be light in weight and relatively simple in design.

This appears to be an ideal weapon with many of our criticisms of the gun mechanism eliminated. But it, too, is not without its problems and shortcomings. The burning time of the propellants is directly related to the ambient temperature, and this variation changes the ballistic path with a resulting reduction in accuracy.

ALL three of the services are devoting considerable effort to developing rocket fuels which are less affected by temperature. A rocket which is fast at low altitudes will be faster at higher altitudes, but in the thinner atmosphere the fin-stabilized rocket loses stability. Under these conditions a spin-stabilized rocket may offer a solution.

The Mighty Mouse, a new rocket developed by the Navy, is now being stockpiled for both the Navy and the Air Force. It is 2.75 inches in diameter and about 4 feet long. It is stabilized by folding fins which do not increase its over-all diameter when clustered. Our ability to fire a large number of these rockets at the same time has made this a superior weapon, and it is being installed in Air Force interceptor aircraft.

Twenty-four can be carried in a retractable launcher in the belly of the North American F-86D Sabre; in the Lockheed F-94C Starfire, twenty-four can be nested around the radar nose. Additional rounds can be carried in separate wing pods.

Smaller rockets with warheads equivalent to that of the 2.75, as well as larger rockets, are under development and will give our interceptors even greater lethality against enemy bombers.

SO far it is in the rôle of high-explosive bombs that atomic weapons have had their greatest influence on air ordnance. But there is still a need for conventional bombs, and we have a continuing program in this area.

This program is aimed primarily at developing bomb shapes compatible with new aircraft designs and capabilities and optimizing the effectiveness of the bomb against specialized targets such as vehicular traffic or troop concentrations.

Increased speeds may produce serious turbulence within open bomb bays, and bombs released at these speeds have been observed to float in the bomb bay before falling away. This not only destroys bombing accuracy but is extremely hazardous. Jettisoning of external stores at high speeds likewise presents new and greater problems.

During the past several years the Air Force has developed a new series of bombs designed for release at high speeds. They are longer and sleeker than the old bombs and have stronger and longer tails to withstand the greater dynamic forces.

More improvement is required, however, and we are looking at shapes entirely different from the conventional ones in order to stabilize bombs as they enter the turbulence of the slip streams.

In conclusion, may I again stress that it is the effectiveness of the system which pays off, not the individual superiority of any one component.

Because aircraft are continuing to fly higher and faster, we must continue a vigorous research and development program in air ordnance. We are relying on the Industry-Ordnance Team to find the best solution to our military requirements.

Aërial Fire Control

Air Force researchers are always seeking a more accurate, reliable, and efficient bombing-navigation system capable of delivering maximum fire by day or night in any kind of weather

Col. Leroy L. Stefen, U.S.A.F.

AIRCRAFT fire-control systems are designed primarily to direct projectiles or rockets against targets—usually enemy aircraft. During the First World War, fire-control systems consisted of ring-and-bead sights which were used to aim the machine guns which fired through the propellers of the fighters. The judgment of the pilot had to be relied upon to put in enough lead ahead of the enemy aircraft to get hits. If he didn't get hits, he was generally instructed to put in more lead.

In the Second World War, the fighter pilots who became aces were often those who in earlier life had had much experience in shooting and hunting. But as aircraft traveled faster, the pilot's judgment was no longer adequate since the time available for firing greatly decreased with the increased speed of the aircraft.

With increased speed, higher altitudes, and greater maneuverability, we went from the ring-and-bead to optical-type sights which were enclosed within the cockpit.

IN Korea, our fighter pilots had an A-1 sight which computed the proper lead, and they also had radar which gave them ranging information. This gunsight greatly contributed to the 13-to-1 ratio of MIG losses to our fighters.

After Russia detonated its first atomic bomb, increased emphasis was placed on our having an all-weather interceptor capability in being. We needed fire-control systems more effective than the A-1 sight which was satisfactory only under conditions of clear visibility.

Colonel Stefen is chief of the Guidance Control Division, Directorate of Development, Air Research and Development Command, Baltimore, Md. This is an address given by Colonel Stefen before the Thirty-sixth Annual Meeting of the A.O.A. at Forth Worth, Tex., May 6, 1954.

Moreover, the A-1 sight brought the fighter in toward the tail of the enemy aircraft in a lead pursuit curve, an action which always ended in a tail chase which results in an interceptor flying into the most heavily defended area of the bomber. It therefore became highly desirable for us to be able to attack from other angles if possible.

In order for us to have an all-weather capability, we must have some means of finding the enemy bomber regardless of visibility conditions. An all-weather fire-control system must have some type of device to search for, locate, home on, or steer toward the bomber.

If such a device could not be built into an aircraft with sufficient range, then the interceptor would need help from the ground in the form of ground-based radar. This addition adds to the cost and complexity of the system.

If the attack run is flown manually, we find that human frailties such as slow reaction time, poor instrument-flying techniques, and errors resulting from apprehension, nervousness, or excitement have an adverse effect on the results.

A possible solution would be to tie in the fire-control system with an autopilot which would then make the attack much more dispassionately than the human pilot.

In comparing guns and rockets for use in interceptors, the rocket appears to have certain advantages over guns because rockets can carry larger warheads and can be discharged all at once at that point in time and space where it is best to fire, thus increasing the probability of effective hits on the target.

THE installation of guidance, such as a radar or infrared seeker, in a rocket would increase the probability of a hit. It would then become a guided aircraft rocket or guided missile but would be more costly, more complicated, and probably less reliable. It would also further complicate the fire-control system but would decrease the accuracy required in the aiming devices. The following are some of the desired characteristics of fire-control systems, not necessarily in order of importance:

(1) High hit probability on a single pass; (2) Versatility (no altitude or weather limitations and use with a variety of weapons); (3) Ability to attack and destroy in the least possible

time; (4) Simplicity of operation and maintenance; (5) Small and lightweight; (6) Reliable; (7) Low in cost.

Many of the same characteristics must be considered for the turret guns of bombardment aircraft. They must be able to find, identify, and lock on to attacking interceptors quickly and process the necessary data to determine the proper time to fire—all without material benefit from a human operator.

A highly desirable turret system would be one which would search throughout a mission, identify, and simultaneously continue to search for other aircraft. The system would then compute the proper lead angle and firing time for the guns, making allowances for such factors as the speed of the bomber and the fighter, and the relative course and range of the interceptor.

THE problems of putting bombs on the target are many and varied. Let us consider, for example, the problems which wind presents.

If a helicopter were to hover over a target at a very low altitude, it would have a high probability of hitting it every time. Raise the helicopter a few thousand feet and the probability drops off. Have it fly over the spot at 5,000 feet and at 50 miles an hour and its probability drops off further.

The proper angle of drop could still be easily computed for that speed and altitude if there were no wind. The wind does several things. It can change the release angle or release point by changing the ground speed or drift. It can effect the trajectory of the bomb during drop, requiring a further correction in the drop point.

Corrections for the effects of wind had been solved by 1923, but bombing devices were crude and drops were made manually. By 1933 the Norden bombsight corrected for the effect of wind more accurately and provided for automatic release.

Before World War II, we boasted that we could do "pickle-barrel" bombing. Under combat conditions we found it difficult to put 50 per cent of our bombs in a 1,000-foot circle with a formation of B-17's and B-24's.

Originally the Norden bombsight gave visual indications on a pilot directional indicator which enabled the pilot to know which way he should fly the aircraft to get to the proper release point. This procedure allowed for many errors. Later versions, those used in World War II, had a tie-in to the autopilot so that the bombardier made corrections in the heading of the aircraft and all the pilot had to do was maintain a predetermined airspeed and altitude.

The Norden sight with the autopilot tie-in did the bulk of our bombing for us in World War II. The limiting factor of the Norden bombsight was that it could be used only for visual bombing. Late in 1943 we received from the British an airborne radar which was capable of bombing through an undercast or at night.

This is the way the early radar bombing system worked: A bombardier was in the nose of the aircraft, a radar operator was several compartments away. The radar operator vocally told the bombardier where to drop the bombs and told the pilot what heading to fly.

There was much room for error because of the time lag and the possibility of difficulty in the interphone system within the aircraft. This system made no adjustments for cross wind and resulted in poor accuracies.

Today's bombing systems have a more refined bombsight tied in with an airborne radar set. They are closely bound together to make an all-weather bombing-navigation system. One man does the navigating, radar operating, and bombing.

DURING reduced visibility conditions, radar can now be used to navigate the aircraft and to locate and bomb the target. Radar, however, is susceptible to jamming—like noise on a radio frequency. Ways must be found to make our bombing systems invulnerable to enemy countermeasures. Another disadvantage in having radar aboard bombing aircraft is that radar transmits electrical energy which can be detected by the enemy.

Not only should we strive to improve present types of bombing-navigation systems, but we should look to the time when we can operate with no dependence on electronic transmissions.

In summary, a good bombing-navigation system should be very accurate, very reliable, operationally flexible—capable of operating at varying altitudes, speeds, and under all weather conditions, and not susceptible to enemy countermeasures. It should be small and lightweight, easily maintained, adaptable for use in many types of aircraft, and low in cost.

The new F-89D "Scorpion" with 2.75-inch wing-tip rockets is brought "on target" electronically in all kinds of weather (Air Force photo).

Packaging in Modern War

The mass production of ordnance is meaningless unless arms and equipment reach our fighting forces in the field quickly, in usable condition, and at a cost the economy can well afford

Col. James N. Sammons, U.S.A.F.

Colonel Sammons is chief, Materials Packaging and Handling, Office of the Deputy Chief of Staff for Materials, Headquarters, U. S. Air Force, Washington, D. C. This is an address given by Colonel Sammons at the Thirty-six Annual Meeting of the A.O.A., Fort Worth, Tex., May 6, 1954.

FOR many years the business of packaging has been considered by both industry and the military services as a side line—a necessary evil, if you will—to the main business of production and operations. It took a great national emergency, World War II, to awaken us all to the fact that there was a necessity for some intensive effort in this field and to the magnitude of the job facing us.

During the early stages of World War II, ton after ton of property arrived at the far-flung corners of the world with as much as one hundred per cent of it completely unserviceable. While most of this damage was undoubtedly due to poor packaging technique, much of it was caused by the cumbersomeness of our logistics system as a whole—the long pipe lines, innumerable handlings, and so forth.

WE did finally realize, however, that production wasn't everything—that it was only that production which reached the fighting lines in good condition that counted. Hence, by the end of the Second World War, damages to munitions due to improper packaging had been drastically reduced.

But most of our progress had been made in the field of preservation, with far too little attention having been given to the management aspects and close control of such things as tare weight and cube, economy, etc.

In other words, we had failed to consider packaging as one of the vital links in the whole logistics chain. We had not yet recognized that packaging cuts directly across the logistics board, having significant effect on practically every logistics operation—mode and cost of transportation, type and amount of storage space, procurement costs and lead time, maintenance costs, and so on.

However, I think that we all now realize, both in industry and the military services, that packaging in itself is a big business. To give you some idea of the magnitude of the Air Force packaging program, we have determined that we spend about one billion dollars a year in packaging operations.

The Department of Commerce has estimated that sales of containers and packaging materials by United States producers during 1953 reached ten billion dollars. This is the exact amount of the total sales of all General Motors Corporation products for the same year.

In recognition of the magnitude of packaging activities in connection with our national defense, the United States Air Force has established at division level, within the Directorate of Transportation at U.S.A.F. Headquarters, a Packaging and Materials Handling Division.

This division is the office of prime responsibility within U.S.A.F. Headquarters for all packaging and materials-handling matters of a planning or directive nature.

IN this office rests management responsibility for the over-all U.S.A.F. program. Operational aspects of the program are the responsibility of the Air Matériel Command located at Wright-Patterson Air Force Base, Dayton, Ohio.

Nearly every one of our Nation's leaders has stated at one time or another that we will not attempt to match the Communist world—the only present potential threat to our security—with numbers, either in manpower or matériel. We are to rely on quality to provide us with superiority.

This concept of quality over quantity was adopted early by the Air Force and, of course, is the objective of our packaging program. And, through the diligent application of sound management principles to our packaging activities, we intend to have this quality for less money.

How do we intend to save money on our packaging without compromising on preservation of matériel during storage and shipment? Simply by con-

sidering packaging in its true position as a part of the logistics chain.

In 1776 a requisition for gunpowder had to be carried by horseback from the battle lines at Portsmouth, N. H., to Boston where the depot was located. The journey of some fifty-seven miles required a full day.

Two and one-half days more were required to haul the powder by wagon from Boston to Portsmouth. After the call was sent out for the powder, it moved toward the battle lines at an average speed of one and one-third miles an hour.

WE do not use horseback riders for communications today, and we don't deliver our supplies in horse-drawn wagons. We requisition our supplies by telephone, telegraph, radio, and air mail, and deliver them by airplanes, fast trucks, trains, ships, and helicopters.

Nevertheless, the average time from requisition to receipt of supplies to a combat commander in Germany during the Second World War was about 106 days, or an average speed of 3½ miles an hour. In 175 years we had increased the speed of supplies to the front by only two miles an hour!

To compensate for this long time interval between request and receipt of property—pipe-line time—we maintained huge depots of supplies to insure logistic support of our forces. And all of you well know the quality of packaging that was required to insure delivery of material in a usable condition under such circumstances.

It was rolled on and off boats, trains, trucks, and airplanes so many times that safe delivery at destination dictated a package which was practically indestructible.

I have read that fifty per cent of the lumber production of this country during World War II was consumed in packaging, packing, and shipping activities.

Let us convert this fifty per cent figure into terms that we can understand more readily. During the war years of 1941 through 1945, United States lumber production totaled 165,157,000,000 board feet. The fifty per cent used for packaging, packing, and shipping amounted to 82,578,500,000 board feet.

At the present average consumption of 9,000 board feet per unit, this would build 9,175,388 one-family dwelling units. Just imagine for a moment, if you will, what this means in terms of transportation funds alone, to say nothing of the waste of critical cargo space, time, matériel, and manpower involved.

Can we ever afford such wasteful operations again? It is doubtful, either from the economic or the military point of view.

Our logistics planners have faced the issue squarely and are determined to reduce the time element between request and receipt of supplies. This shorter time element will, of course, provide additional savings in the reduction of inventories.

Further, fast turnover means shorter storage periods, lower storage space requirements, less handling, and, naturally, lowered packaging requirements.

In any modern logistics system, high-speed transportation is a "must." If inventories are to be reduced, means must be provided for rapid distribution of what remains. I do not need to dwell on the enormous strides that have been taken in this direction since the Second World War by our aviation industry as well as our shipbuilders, railroads, and truck lines.

There is hardly a day that passes without some new record being set for speed by some type of transportation medium. Obviously, we will exploit all these products of our ingenious American industry to the fullest extent possible to obtain a faster flow of matériel.

BUT as transport systems become faster, equipment used becomes more and more expensive. Since the package of itself contributes nothing to the combat effectiveness of an item of equipment we must reduce that package to the absolute minimum in order to obtain the greatest possible utilization of these expensive pieces of transportation equipment.

We can't afford to buy enough high-speed transport aircraft, for example, to permit us to fill them up with wooden boxes weighing as much as or more than the materials they contain. In the past, for every pound of matériel shipped to the field we have shipped about three pounds of packaging.

This leads to the problem of cargo-handling and materials-handling systems. Now that we have a family of fast conveyances we must devise methods of rapidly loading and unloading cargo to permit a quick turnaround.

This is particularly true in the case of transport airplanes. We gain little if we move cargo across the ocean at sonic speed only to have the airplane remain on the ground for a day or two for loading and unloading operations. We must plan our cargo-handling operations around the time required to service the airplane.

It seems to me that there is only one approach to this problem and that is to handle the cargo in larger packages. It appears that a standardized, preloaded, all-weather container, adaptable to all types of conveyances, is a "must." Such containers will also drastically reduce packaging requirements in addition to serving the primary objective, in this case, of permitting rapid handling.

We have done considerable work in this preloaded-container field and our tests, though incomplete, indicate that we are moving in the right direction.

IN any examination of the materials-handling problem one invariably gets involved in the subject of terminals.

There has been a lot of thought given to the design of air terminals that would provide an ideal materials-handling situation, but I have heard little about ways to by-pass the terminal altogether.

We must have terminals for certain types of cargo and passenger activities but, in general, I think their importance to the military from a cargo-handling point of view is growing less by the day. Give a man an elaborate terminal with conveyors, ramps, etc., and you give him an opportunity, even encouragement, to handle his cargo one extra time.

In our zeal to isolate and solve the individual technical packaging problems we have sometimes lost sight of our objective—a package designed to mesh with the other elements of the whole logistics system. Personally, I have never seen a pure packaging problem. Other elements of the logistic system are always present.

Packaging and materials handling are considered by most segments of industry to be the remaining field in industrial management which can yield enormous savings in dollars and manpower, and we feel that the same is true with these activities in the Air Force.

Fatigue Testing Machine

New electronic controls have been added to the General Motors testing machine at Watertown to increase accuracy and range of measurement in calculating fatigue of metals

David E. Driscoll

ONE part of the present equipment in the mechanical testing section of the Watertown Arsenal is the General Motors fatigue testing machine. This machine is primarily a tension and compression loading device with a capacity of 100,000 pounds in each direction. Torsional loads up to 5,000 inch-pounds can also be applied and phased in at any part of the tension and compression cycle.

The cycling rate of this machine is from 400 to 3,000 cycles a minute. Loads are obtained statically by a 100-p.s.i. oil supply acting on a 100-square-inch piston. Load is recorded on a Bourdon tube. Deflections up to one inch may be obtained to the full load capacity of the machine.

Dynamic loads are obtained by two double-acting hydraulic actuating pistons, with a combined total area of 11.347 square inches, acting upon the main piston. Deflections up to 0.170-inch may be obtained up to 100,000 pounds.

THE dynamic load, to which the test part is loaded, is determined from the static load deflection of the part. This is measured by micrometer contactors, each set to light a neon lamp when the test part is loaded statically to the load desired. Then the machine is operated dynamically and control valves adjusted until the neon lamps just flash. When this is done, the test part is loaded dynamically to the same load that the neon lights indicated statically.

This machine originally was the constant-deflection type, and methods for measuring, programming, and controlling the dynamic performance of the machine were manual, except for the use of stroke-limit contacts and a cycle counter.

As loads are controlled by deflection, the fatigue cycle was good until the specimen actually started to fatigue, due to development of cracks or elongation of specimen. This caused the load to drop while the deflection was held constant, producing erroneous results.

To carry out Ordnance development tests, the need arose for automatic control equipment that would enable fatigue tests to be conducted on the General Motors fatigue machine at values of constant axial force or deflection or constant torsional force or constant torsional deflection during the entire specimen life and over the full load range of the machine.

In general, the function of such necessary electronic control circuits is to collect electrical information on how the fatigue machine is performing (through sensing elements) and what the machine is supposed to be doing (by preset signal) and then to instruct the control motors when and how to operate to make the machine apply the loads or deflections required.

Mr. Driscoll is chief of the mechanical testing section, Watertown Arsenal Laboratory, Watertown, Mass.

The electronic control panel has two Bourdon tubes at the top, the one on the left showing axial force and the one on the right showing torsional forces. Below these are dual-beam Dumont cathode-ray oscilloscopes. The one on the left is used to set and control axial loads or deflections, and the one on the right is used to set and control torsional loads and deflections.

THE center single-beam Dumont cathode-ray oscilloscope can be used to jack in any one of the axial or torsional load or deflection and bending patterns to spot-check a single pattern.

Both sides of this oscilloscope have provisions for the insertions of jacks to obtain Brush recorder permanent records of load, deflection, and bending.

The anticipated second phase of this project is to design, develop, and construct a hydromechanical wave-form simulator to be used with the fatigue testing machine and the new electronic control panel.

This simulator is essential because there is an increasing need for test equipment that is capable of reproducing actual force-time and deflection-time functions imposed during active service of Ordnance matériel.

It is believed that the resulting test facility will be the first of its kind and make possible a better understanding of force, deflection, and time as they relate to the phenomenon of fatigue.

Index of Advertisements

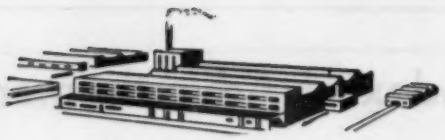
JULY-AUGUST 1954

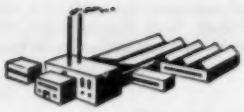
The following companies have shown by their interest in the design and production of ordnance that they are ready to serve the United States through industrial preparedness for national security and peace. Such companies as these are indicative of the industrial strength of the Nation upon which the military might of the armed forces depends.

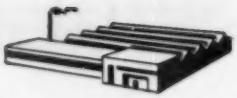
	Page
Abbott Ball Company	151
AC Spark Plug Division, GMC	25
Aerojet-General Corporation	26
Aetna-Standard Engineering Company	86
Allis-Chalmers Manufacturing Company	6
Allison Division, GMC	22
Aluminum Company of America	89
American Chemical Paint Company	20
American Machine & Foundry Company	138
Arma Corporation	IV Cover
Armstrong Cork Company	151
Arnold Engineering Company	152
Aviation Developments, Inc.	112
Barnes Company, W. F. and John	5
Bassick Company	147
Bell Telephone Laboratories	2
Bendix Aviation Corporation	111, 144, 148
Blaw-Knox Company	12
Bliss Company, E. W.	124
Borg Corporation, George W.	132
Breeze Corporations, Inc.	108
Buffalo Forge Company	146
Bundy Tubing Company	7
Cameron Iron Works, Inc.	11
Caterpillar Tractor Co.	3
Chrysler Corporation	91
Cleveland Container Company	100
Commercial Contracting Corporation	107
Continental Motors Corporation	21
Crosley Division—Avco Manufacturing Corporation	145
Danly Machine Specialties, Inc.	129
Daystrom Instrument Division, Daystrom, Incorporated	123
Dempster Brothers, Inc.	93
Du Pont de Nemours & Company, E. I.	4, 87
Eastern Tool & Manufacturing Company	136
Eaton Manufacturing Company	92
Electric Storage Battery Company	117
Englander Company	139
Exact Weight Scale Company	150
Fairchild Engine and Airplane Corporation	119, Facing 129
Farrel-Birmingham Company	110
Follows Gear Shaper Company	90
Ford Instrument Company, Division Sperry Corporation	95
Fuller Brush Company	150
Glidden Company	99
Gray Manufacturing Company	103
Great Lakes Steel Corporation	13
Heckethorn Manufacturing and Supply Company	14
Hunter Douglas Corporation	18

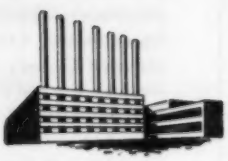
	Page
International Business Machines Corporation	24
International Harvester Company	10
International Nickel Company	126
Jennison-Wright Corporation	127
Kaman Aircraft Corporation	116
Kelsey-Hayes Wheel Company	Facing 128
King-Seeley Corporation	137
Kwikset Locks, Inc.	19
Lapointe Machine Tool Company	141
Luria Engineering Corporation	98
Lycoming Divisions—Avco Manufacturing Corporation	130
Magnetic Metals Company	30
Martin Company, Glenn L.	133
Mason & Hanger Company	118
Maxson Corporation, W. L.	9
National Malleable & Steel Castings Company	102
National Tube Division, U. S. Steel Corporation	120
New Departure Division, GMC	17
Niagara Blower Company	150
North American Aviation, Inc.	143
Oakite Products, Inc.	85
Parker Rust Proof Company	88
Phoenix Products Company	144
Pittsburgh Plate Glass Company	29
Precision Castings Company	125
Pressed Steel Car Company	168
Radio Corporation of America	115
Remington Arms Company	28
Rheem Manufacturing Company	109
Riverside Foundry	97
Rolock, Inc.	104
Sheffield Corporation	101
Sperry Gyroscope Company	15
Spicer Manufacturing Division, Dana Corporation,	Facing 96, 97
Steel Products Engineering Company	105
Stokes Machine Company, F. J.	135
Stromberg-Carlson Company	140
Surface Combustion Corporation	149
Swift Industries, Inc.	122
Tenney Engineering, Inc.	8
Timken Roller Bearing Company	III Cover
Triplex Industries, Inc.	II Cover
Tung-Sol Electric, Inc.	96
United Chromium, Inc.	142
Waterbury Farrel Foundry & Machine Company	94
Wirebound Box Manufacturers Association	16
Wolverine Tube Division, Calumet & Hecla, Inc.	113
Young Radiator Company	114
Zenith Radio Corporation	27

ORDNANCE *is set up, printed, and bound for the American Ordnance Association by the William Byrd Press, Inc., Richmond, Va.*









PRODUCTS and FACILITIES Serving Many Industries

Pressed Steel Car Company offers a broad range of products and services available to industry throughout the world. Alert to new processes and technological advances, Pressed Steel Car Company throughout the years has maintained a reputation for more efficient, higher quality products.

ALL OUTSTANDING PERFORMERS — ***these products range from . . . . . .***

- Locomotives and trackwork to cookware
- Agricultural and farm machines to milk cans
- Railroad and industrial cars to oil pumping machinery
- Engine lathes and conduit fittings to steel tanks
- Power plants to cellular laminated containers and shelters

Products to Serve Industry . . . Farm . . . and Home Railway Freight Cars (Mainline) • Industrial Railway Cars for agriculture, mining, construction, factory and mill service • Permanent and Portable Industrial Railway Track Equipment • Locomotives for mainline switching and all industrial railway service • Clay, Brick and Tile Machinery • Railway Inspection and Gang Cars • Weed Burners • Unistrut Metal Framing Hydraulic Pumping Units • Precision Deep Well Plunger Pumps • Steel Sucker Rods • Engine Lathes • Aircraft Landing Gear Shock Struts • Precision Gears & Gear Mechanisms • Dairy Cans & Equipment • Self-Closing Receptacles • Permanent Cookware • Farm Holding Tanks • Storage Hoppers • Alloy Steel Containers • Oil Storage Tanks • Rendering and Softening Tanks • Agitators • Smoke Stacks • Dust Collectors • Coal and Ash Hoppers • Lock Nuts & Bushings • Couplings & Connectors • Fittings & Electrical Accessories • Unishelter Homes

New York
Chicago
Los Angeles
Honolulu
London
Mexico City
Manila
San Juan

PSC

PRESSED STEEL CAR CO., INC. 6 No. Michigan Ave. Chicago, Illinois

"Old reliable" 21 in. sliding head floor drill stays accurate *with spindle on TIMKEN® bearings*

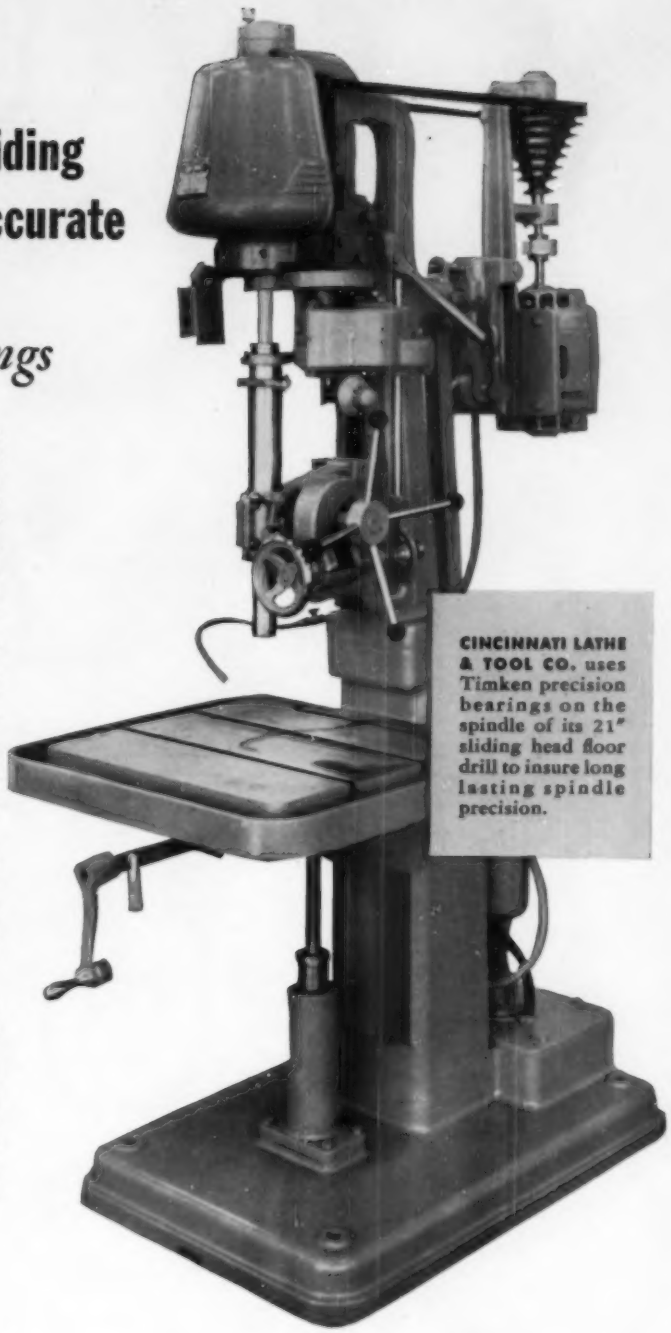
THE long-lasting precision of this Cincinnati 21" sliding head floor drill has earned it the nickname "Old Reliable". One reason for this precision: the spindle is mounted on Timken® tapered roller bearings which are supported in an accurately ground and graduated quill. Two tapered roller bearings support the quill and two support the spindle pulley.

Timken precision bearings are especially designed for spindle applications. Run-out tolerances can be held to a maximum of 75 millionths of an inch. Due to their tapered construction, Timken bearings take both radial and thrust loads in any combinations, hold spindle rigid, permit pre-loading to any desired degree to prevent chatter.

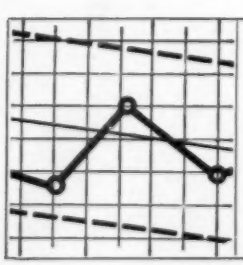
Because of line contact between rollers and races, Timken bearings provide adequate capacity for any tool load. And spindle accuracy can always be maintained because Timken precision bearings are adjustable.

Timken bearings have contributed to the development of precision machine tools for over 25 years. To get longer life with minimum maintenance, buy or build machine tools that are Timken bearing equipped. Always look for the trade-mark "Timken" stamped on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



CINCINNATI LATHE & TOOL CO. uses Timken precision bearings on the spindle of its 21" sliding head floor drill to insure long lasting spindle precision.



STATISTICAL QUALITY CONTROL

To insure uniform high quality and closer tolerances, the Timken Company uses statistical quality control. With it, tolerance deviations are plotted graphically. It's one of industry's newest, most scientific methods of improving product uniformity.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

NOT JUST A BALL NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

Killer instinct

Almost by "instinct," tomorrow's missiles will seek out and destroy submerged subs. Controlling weapons and providing them with "instinct" typifies systems made by Arma Corporation.

Arma Corporation, Brooklyn, N.Y.; Garden City, N.Y.
Subsidiary of the American Bosch Corporation.

ARMA ADVANCED ELECTRONICS FOR CONTROL

Arma is a good place to work